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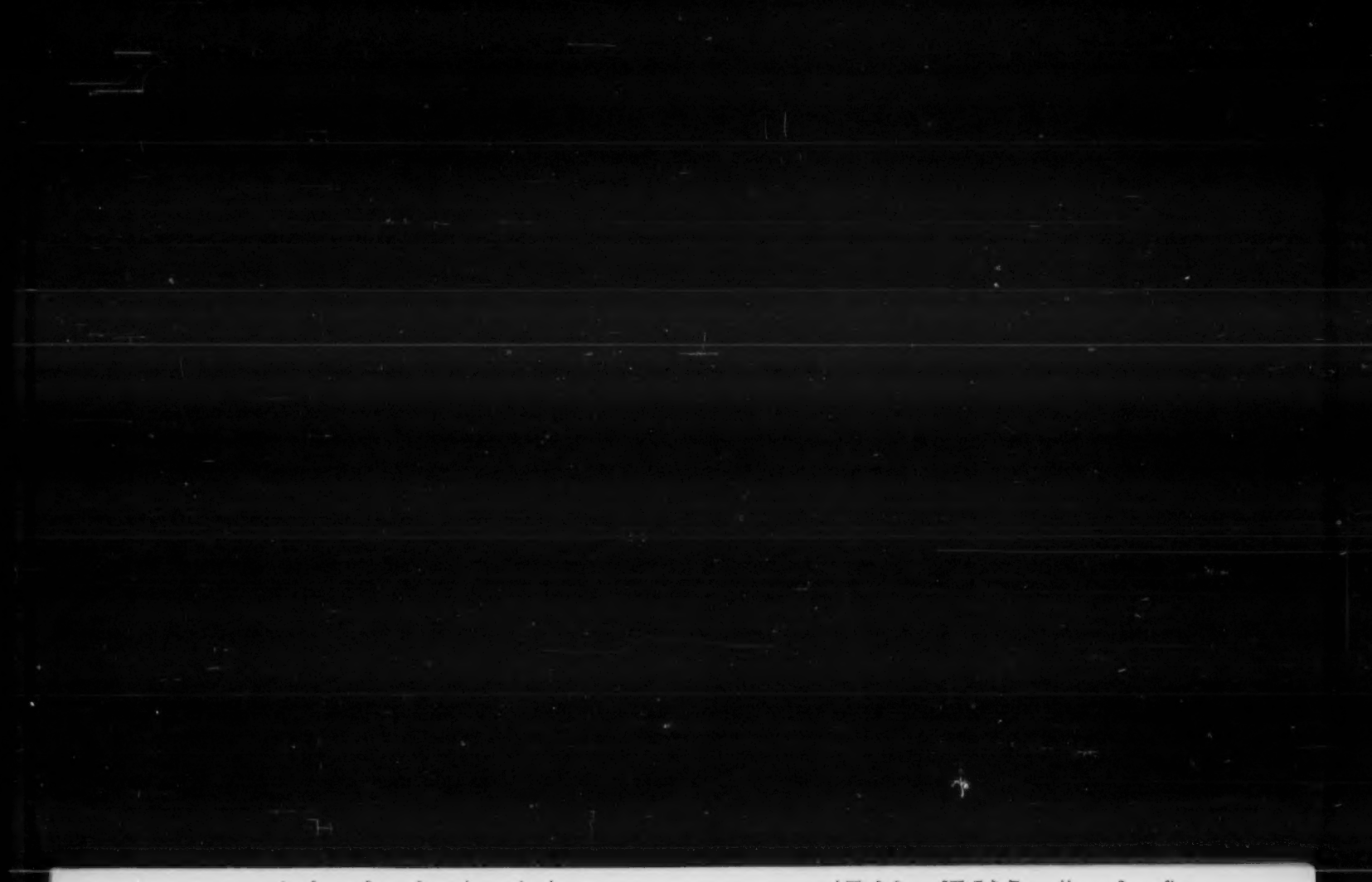

AMERICAN ANTIQUITY

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NORTH AMERICAN COOKING POTS[1]

RALPH LINTON

IT SEEMS to be a general rule that sciences begin their development with the study of the unusual. They have to develop considerable sophistication before they interest themselves in the commonplace. American archaeology has been no exception. It began with digging in mounds and the collecting of choice objects and has now progressed to the excavation of camp sites and the delimitation of culture complexes as wholes. Nevertheless, there is still a tendency to underrate the importance of simple utilitarian artifacts of types which are widely distributed in space and time. This may be justifiable as long as the archaeologist's interest is centered on foci and aspects, but such types become of extreme importance as soon as one attempts to broaden the frame of reference. Thus the fact that certain stone artifact types seem to be present throughout most of the area east of the Rockies, from Folsom on, becomes highly significant when we contrast this area with others in the New and Old Worlds. Simple tools and utensils which serve their purpose adequately are among the best guides to culture origins and continuities. They become integrated into the largely unconscious business of daily living and tend to persist untouched by contact with neighboring cultures or by changing fashions. Once established as part of the cultural heritage of a society, they are rarely displaced and may survive all sorts of migrations and mergers. Much has been made of the conservatism of religion, but it is as nothing to the conservatism of house wife and artisan going about their accustomed tasks with their familiar tools. If we seek for ancient survivals in our own material culture we will find many more of them in the tool chest and kitchen drawer than in the church. Vestments and monstrances may go back to the days of the later Roman Empire, but chisel, gouge and transverse-bladed chopping knife go back to the Neolithic.

It is hoped that this paper may stimulate other investigations in

[1] I wish to express my gratitude to Dr. Gordon Willey, Dr. George Quimby and Mr. Carlyle Smith for information on the pottery of the Southeast; to Mr. Paul Cooper for information on that of the Plains; and to all four for stimulating discussions in the course of which the ideas embodied in this paper were developed. I also wish to thank Dr. James Griffin for numerous criticisms and suggestions while exonerating him from any responsibility for the views herein expressed.

this relatively neglected field by showing some of the conclusions which may be drawn from the study of one humble utilitarian appliance, the cooking pot. Since the investigation was largely experimental, it was deliberately limited to the region north of Mexico and the Antilles. However, even in this region there appear to be regional differences in the form, method of usage, and relative frequency of cooking pots which may have significant implications.

For purposes of the present discussion, a cooking pot will be taken to be any pottery utensil which is structurally adapted to boiling food by the process of bringing the utensil into contact with a fire. It is often impossible to say whether a particular piece of pottery, found archaeologically, was used for boiling food or not, but it is relatively easy to determine whether it was suited for boiling. Although it is perfectly feasible to boil fluids in broad, shallow utensils such as bowls, we find that, in practice, vessels of this type are rarely used for boiling. Moreover, it seems that they are never the dominant form employed for this purpose when vessels of other shapes are available. The wide mouths of bowls provide so much surface for evaporation relative to the heating surface and fluid content that such utensils soon boil dry. They are adapted to warming fluids or to brief cooking but not to the slow, long-continued boiling required by most staple foods. Conversely, vessels with relatively narrow, constricted mouths, especially when these are combined with elongated necks, are also unsuited to food boiling. In such forms the steam generated in the body of the vessel becomes too concentrated at its mouth, causing the contents to boil over. Anyone who doubts these generalizations can verify them for himself with the aid of a saucepan and a milk bottle. The effective cooking pot must have a mouth large enough to prevent explosive boiling over and to permit of stirring its contents, but at the same time small enough, relative to the pot's capacity and heating surface, to prevent it from boiling dry every few minutes. Primitive potters must have discovered these facts through experience, and adjusted their designs to them. However, within the limits thus imposed, considerable variation in form was still possible. It is with these variations and their regional distributions that I propose to deal.

Recent investigations have greatly increased the area in North America in which pottery is known to have been used at one time or another. In addition to the long recognized Southeastern and Southwestern areas of high pottery development, there appears to have been a northern area in which it was also basic to the food economy. This area included the northeastern Woodlands, the Great Lakes region, the northern Plains, that part of the Rocky Mountain Plateau lying north of the agricultural zone, and the territory northward, with occa-

sional breaks, to the Arctic Ocean and Bering Strait. Throughout this vast region the forms of the utensils indicate that pottery had an exceedingly limited, specific usage. All the vessels found, with the exception of the clay lamps of certain Eskimo tribes, were structurally adapted to food boiling. Even the smallest or most ornate vessels were shaped like cooking pots. In spite of some variability in form and the irregularities due to crude workmanship, two basic types are recognizable. One of these has a pointed bottom, the familiar Woodland type; the other a flattened bottom and outward-sloping sides, the "flower pot" form. Both these types are normally tall relative to their diameter and appear to have been used in the same way. Their small bottoms and the general absence of flaring rims, handles or other adjustments for suspension indicate that they were set directly *in* the fire rather than supported *over* it. In this method of usage, the effectiveness of the pot depended upon the area of lateral surface, since this was the part of the vessel exposed to the flame. Tall pots with long, gently outward-sloping sides were the most efficient. Shoulders or constricted necks, while they might help to conserve heat, represented a loss in heating area and were rarely employed.

The apparent limitation of pottery to food boiling in this area, and the technique of cooking with flame rather than over coals both appear to be functionally related to a more or less nomadic existence. It would be easy for a family to transport one or two cooking pots and protect them from breakage. Utensils which did not have to be brought into contact with the fire, as bowls, spoons or storage vessels, could be and were made from less fragile materials, as wood, horn, or bark. Moreover, the technique of flame cooking was ideally suited to the temporary camp. A few stones sufficed to hold even the pointed-bottomed pots upright and their contents began to heat as soon as the fire had been kindled around them.

It has long been recognized that there are many elements of culture which are common to the semi-nomadic hunting and fishing peoples of far northern Eurasia and America and it seems probable that the type of pottery just discussed should be classed with these. In both areas we find the use of pottery limited to cooking pots, or at least to utensils structurally adapted to food boiling. The "Woodland" shape is found throughout the far northern Eurasian cultures while the "flower pot" shape finds close parallels in Kamchatka and even in northern Japan.[2] Resemblances in paste, decoration and surface finish are so close and numerous that many of these Old World pots would be accepted unhesitatingly as American Woodland if their provenience were

[2] de Laguna, 1940.

unknown. The Eurasiatic pottery of this type seems to have been developed in late Paleolithic times by peoples of the northern forest zone and to bear little if any resemblance to that produced by the earliest Neolithic farmers of the Old World. It seems probable that it was introduced into North America in developed form and that, in its subsequent diffusion on this continent, it underwent only minor changes. Throughout its history in both the Old and New Worlds this northern type of pottery seems to have been closely associated with a hunting and fishing economy and to have tended to be replaced by superior types of pottery wherever agriculture was introduced.

If the northern type of pottery was diffused into America from the Old World, the time of its introduction remains to be determined. That it was not brought in by the first American migrants is abundantly proved by the presence of early non-pottery cultures in many regions where pottery later became important. It is lacking even in the relatively recent Archaic cultures of the northeastern Woodlands, suggesting that its introduction cannot have been very ancient. However, it seems to have been the first type of pottery to be used throughout most of American north of Mexico. It was preceded by other types along the Gulf Coast and possibly in the Lower Mississippi Valley and there are no indications of its presence or even influence in the earliest pottery horizons of the Southwest.

By the beginning of the historic period pottery making had become highly developed in the Southeast and the Mississippi Valley, with a considerable diversity of both wares and utensil forms. Between this continuous area of high development and the regions then occupied by pottery of the northern type there lay a relatively narrow zone of pottery-using cultures which were, in certain respects, intermediate between the two. In this zone, as in the north, pottery was normally limited to forms adapted to food boiling, although a few small bowls and other utensil forms appear in some of the cultures of this group in the protohistoric period. However, the cooking pots of this intermediate zone were markedly different from the northern ones. They were predominantly globular, with broad, low bodies, well-marked shoulders and rounded bottoms. Handles, flaring rims and other features which might be functionally related to suspension were common, while the form of the vessels themselves indicates that they were used *over* rather than *in* the fire. The smaller ones may have been hung from a frame of some sort, while the larger ones were probably supported on rests high enough to allow stoking from below. The wares of this zone also tend to be harder, thinner and of greater tensile strength than the northern pottery, making this method of usage more feasible.

It seems possible that there was some sort of functional relationship between pottery of this type and sedentary life. Cooking pots which did not have to be transported on the march could be made thinner and more fragile than those which did have to be transported. Moreover, given a permanent fireplace with hanging frame or pot supports and accumulated coals, the broad, round-bottomed pot was actually more efficient than the tall northern form. Since it relied for heat upon coals rather than upon flames, it required less fresh fuel. Actually, we find that all the tribes who employed this type were agricultural and sedentary, although not all the agricultural groups of the northern fringe employed it.

Throughout most of what I have chosen to call the intermediate zone, the round-bottomed cooking pot seems to have appeared in relatively recent times. Most of the cultural horizons in which it occurs are underlaid by older ones containing pottery of northern type. Since such round-bottomed cooking pots are also characteristic of the rich and vigorous Middle Mississippi culture, their presence in the intermediate zone may well be due to diffusion of either the direct or stimulus variety. However, their constant linkage with agriculture suggests that it was the spread of this technique and of the settled life which it made possible which opened the way for their diffusion. That the tribes which accepted them did not accept the rest of the Middle Mississippi pottery complex suggests that these tribes were still operating in the conceptual context of the northern pottery area. Apparently they regarded pottery simply as an appliance for boiling food, and we know that even at the beginning of the historic period the tribes of the intermediate zone normally employed wood, horn or bark for all utensils which did not have to be exposed to the fire.

This same conceptual context may account for the failure of painted pottery to spread into the intermediate zone. That this failure was not due to any lack of aesthetic interest is shown by the usage of various other forms of surface decoration both here and in the north. As long as pottery was limited to cooking pots, or thought of only in terms of cooking pots, there was no point in decorating it with colors which would be obscured the first time it was smoked over the fire. On the other hand, modeled or incised decoration, cord markings, etc. could stand a good deal of smoking without being obscured, and offered an effective outlet for the aesthetic urge. Even in the areas where pottery painting was highly developed we find that cooking pots were usually either left plain or were decorated with incised or modeled details.

All the tribes who used pottery of either the northern or intermediate types seem to have given up its manufacture within a few years

of their first contact with Europeans. Much has been made of the rapid abandonment of pottery by the ancestors of various Plains tribes at the time that they acquired the horse and shifted from an agricultural to a nomadic hunting economy. However, a number of other tribes who continued to live as settled agriculturalists seem to have given it up almost as speedily. The reason seems to lie in the very limited role of pottery in the cultures of these groups. As a simple food-boiling appliance it could be replaced immediately and completely by the vastly superior metal kettles of the white traders. Its disappearance was on a par with the disappearance of the stone knife as soon as the iron one became available. In other pottery-making regions, where its uses and associations were more varied, its replacement by European goods was more difficult and it tended to survive much longer.

In contrast with the areas just discussed, both the Southeast and Southwest have been characterized throughout most of their history by a multiplicity of pottery forms and uses. Since the present discussion is limited to cooking pots, no attempt will be made to describe the various pottery complexes of these regions in detail. However, it would be exceedingly valuable to have more information both on the size of the utensils which seem structurally adapted to food boiling and on their frequencies relative to other forms present in these complexes. In spite of the difficulties for sites in which restorable vessels are rare, even approximate statements on these points would help to establish the relative importance of food boiling in the local economies and thus give additional clues to cultural relationships. That there may be significant differences in the extent to which this method of cooking was employed, is frequently overlooked. Primitive peoples outside America differ greatly in this respect and at least one group, the Polynesians, has refused to accept food boiling in spite of long contact with Europeans. Especially in the absence of condiments, boiled foods tend to be flat and uninteresting and a preference for them might almost be called an acquired taste. The pre-pottery peoples of North America must have developed many cooking techniques and there was only one of these, stone boiling, for which pottery boiling could be substituted without impairment of flavor. Pottery making and food boiling are distinct culture traits. The latter may be found without the former, as on the Northwest Coast, and it seems to be an open question whether the two may not move independently in diffusion situations.

It seems fairly well established that the pottery-making complexes of the Southeast were not of homogeneous origin. On the South Atlantic Coast, pottery first appeared in the Stallings Island culture. The earliest vessels were large, rather shallow fiber-tempered bowls which were certainly utilitarian and which might have been used for food boiling, al-

though poorly adapted to this purpose. They were succeeded, in the Deptford period, by elongated, conical-based cooking pots which appear to be in the northern tradition. There is good reason to believe that this form was actually diffused from the northern area by way of the Atlantic Coast. It continued dominant through the Swift Creek period in Georgia, toward the end of which new influences came in from two directions. Necked jars and vessels with flat, square bottoms were diffused from the lower Mississippi Valley by way of the Gulf Coast, while from the north, along the Atlantic seaboard, a wave of pointed-bottomed, cord-marked Woodland pottery established itself as far south as Savannah. Slightly later, Middle Mississippian elements appeared, coming from the northwest. In this line of Southeastern development, pottery boiling was clearly a dominant form of food preparation from at least the Deptford period on, and the number of forms other than cooking pots which occurred in the earlier periods is exceedingly small. In the later periods these forms became more numerous, but their presence can probably be explained by diffusion from the north and west.

The earliest pottery of the lower Mississippi Valley differs markedly from the foregoing. A few small hemispherical bowls were present from the first, but the dominant form appears to have been a relatively deep, flat-bottomed jar with, in many cases, low tetrapod supports. Such jars occur with numerous variations ranging from cylindrical to "flower pot" shapes. However, these variations grade into each other in such a way as to suggest that the various shapes had not become standardized. Most of the utensils are small, but there are a few pots large enough to have been used for food boiling. The form of these, and the extensive smoking of many sherds suggests that they were set directly in the fire, in northern fashion.

The affiliations of this complex are still obscure. The presence of relatively well-made and elaborately decorated vessels in even the earliest levels makes it improbable that the pottery-making technique was developed locally. Although there are resemblances between the Tchefuncte and Marksville jars and the "flower pot" forms of the northern complex, the pointed jars which are much more characteristic of this complex appear to be lacking. In addition, tetrapod supports do not appear in the north before Adena nor does the distinctive type of incised decoration found on these southern wares appear there before Hopewell. Since cylindrical vessels, flat bottoms with tetrapod supports, and elaborate incised decoration are all of frequent occurrence in the coastal cultures of Middle America, there would seem to be a fair chance that these early wares of the lower Mississippi Valley reflect a southern rather than a northern influence. Final solution of this prob-

lem must await the establishment of more exact chronologies for the Mississippi Valley.

The Middle Mississippi pottery complex, which was certainly later in time than most of those just discussed, appears to have been the first eastern complex to exploit the full potentialities of the pottery-making technique. It was characterized not only by great variety in form and decoration of utensils but also by a tendency for each of its aspects to standardize certain forms which were, presumably, made for specific purposes. One of these forms deserves special mention in view of its possible connection with food preparation. Large shallow pottery trays, commonly called salt pans, are a common feature of Middle Mississippi sites. Although they may have been used for extracting salt in certain regions, they are found in many others where no salt is available. It seems probable that their main use was for parching corn or for toasting acorns in ashes to remove the tannic acid, a practice mentioned by early travelers. Food boiling seems to have been well developed with cooking pots of round-bottomed, globular form. It seems difficult to derive this type of cooking pot, or indeed many of the other utensil forms present in Middle Mississippi, from any of the older eastern complexes. However, if the sudden flowering of Middle Mississippi was due to influences from outside the area, the nature of these and the direction from which they came cannot be established at present. In particular, any attempt to equate this complex with any of the Southwestern ones should take into account the chronology of the Southwest and the forms in use there at the time that Middle Mississippi appeared.

The history of pottery in the Southwest presents some exceedingly interesting problems. On the basis of tree ring dating, the Mogollon pottery complex appears to be the oldest in this region. It is characterized from the first by a moderate variety of forms, with cooking pots and bowls predominating. The cooking pots are round-bottomed and moderately tall in proportion to their width but their shape cannot be equated with that of those in common use in any of the northern or eastern pottery complexes. Although small examples are common, large ones are rather rare, suggesting that bulky foods were commonly prepared by some method other than boiling. Numerous grinding stones may indicate that corn was used in *pinole* or griddle cake form, while the frequent large roasting pits may have been used for cooking other foods beside mescal. The later and much more elaborate Hohokam pottery complex employed many large cooking pots of globular form, but, in view of the strong Mexican affiliations of this culture, the new type may have been diffused from the south rather than developed locally.

In the Anasazi line, the earliest pottery, that from Basketmaker III,

shows a surprising variety of forms. These include small, round-bottomed cooking pots, but such utensils are relatively rare, a fact which seems to have escaped notice due to the tendency of archaeologists to lump together all undecorated pottery under the single heading "utility ware." Actually, most of the undecorated pottery from Basketmaker III sites is of shapes quite unsuited to food boiling. Whether the Basketmaker III people developed pottery independently or borrowed it from some other culture is still an unsettled question, but one is forced to conclude that its use for food boiling was quite secondary in their economy. Presumably they had developed other methods of cooking during the pre-pottery period and preferred these for most purposes.

It seems possible that the small cooking pots of both the Mogollon and Basketmaker III cultures were special appliances for cooking beans. The relationship of this important protein source to pottery boiling is of the closest sort. Although beans can be eaten after parching, the usual method of preparing them everywhere in aboriginal America was by slow boiling. Both this and the alternate process of baking in fluid requires the use of pottery. It would test even the patience of an Indian to cook beans tender by the stone-boiling method. We know that beans first appeared in the Anasazi culture line in Basketmaker III and it seems probable that both the technique of boiling them and the utensils suited to this purpose were introduced with them.

The simultaneous use of pottery vessels of many forms continued throughout Anasazi history, but the further development of the cooking pot presents certain points of interest. In Pueblo I, cooking pots were still round-bottomed and were, for the most, part, too small for the preparation of bulky foods. Neck coils first appeared at this time, foreshadowing the later corrugated wares. Data on the frequency of cooking pots during this brief period are, unfortunately, lacking. In Pueblo II the corrugated cooking pot appeared. McGregor says, "The earliest form is a medium-sized, large-mouthed jar, in which indented corrugations form a band only in the neck portion. . . . Almost immediately the idea of corrugating the entire surface of the vessel seems to have been developed. . . . This type dates some time near A.D. 885."[3] It is interesting to note that the earliest of these corrugated pots, as illustrated by the same author,[4] is pointed-bottomed with an outline strongly reminiscent of cooking pots of the northern pottery complex. Unfortunately there is no information on whether the paste of these earliest corrugated cooking pots is the same as that of the accompanying pottery of other shapes. In the further development of the cooking pot

[3] McGregor, 1941, pp. 253–254.

[4] *Ibid.*, Fig. 109, p. 254.

in Pueblo III there was a return to the round bottom, but the vessels are generally long-bodied, in marked contrast to the short bodies and elongated necks of the pre-corrugated ware cooking pots. This shape, together with the heavy soot incrustation found on many specimens, seems to indicate that they were set directly in a flaming fire, in northern fashion. With the appearance of corrugated wares, there is also a marked increase in the size and number of cooking pots, suggesting a much greater use of boiling as a technique of food preparation.

In the Pueblo III period, corrugated cooking pots differ so sharply from other Anasazi utensils not only in surface treatment but also in paste that, if the two were not found in constant association, they would certainly be assigned to different pottery complexes. Curiously enough, this sharp distinction between cooking pottery and other pottery is also recognizable in two other cultures which are marginal to the main stream of Anasazi development. In the Rosa culture of the Gobernador region[5] the decorated pottery is closely similar to, although not identical with, that of the contemporary Basketmaker III culture of the Durango region. The cooking pots differ sharply from the painted ware in both paste and surface treatment. They are round-bottomed, like the Basketmaker III cooking pots, but there the resemblance ceases. The Rosa pots are, with few exceptions, basket-marked at the base but not above, indicating that construction was begun in a small basket, probably made especially for this purpose. The exterior above the basket markings was rubbed with a bunch of grass or pine needles while the clay was wet, producing a rough surface. An even more striking difference between this culture and Basketmaker III lies in the frequency of large cooking pots and the great number of pots relative to other utensils. They were more numerous than all other forms combined, indicating a heavy dependence upon boiling as a method of food preparation. The affiliations of these Rosa cooking pots are uncertain. Their surface treatment can be paralleled in some of the Mogollon wares, also in some Woodland pottery and in historic Arikara.[6] However, they do not resemble the Mogollon wares in other respects. Their form and paste is reminiscent of some of the cruder wares from the Plains which belong to what we have called the intermediate zone, but the basket imprints find no parallels there while the peculiar surface finish has only sporadic parallels.

In the Gallina culture,[7] considerably later than the Rosa culture but also marginal to the Anasazi area, the painted wares are again closely related to contemporary Anasazi types. However, the cooking

[5] Hall, N. D. [6] Dr. James Griffin, personal communication.
[7] Mera, 1938; Hibben, 1938.

pots are tall and slender with pointed bottoms. They bear a close resemblance to those of the historic Navaho. It is exceedingly difficult to derive this form from any one of the other Southwestern forms and it seems highly probable that it stems from the northern pottery complex. In particular, it may be related to the plain-surfaced ware found north along the Plateau into the Northwest.[8]

In view of these facts, it may be tentatively suggested that the sharp difference between cooking wares and other wares in the Rosa, Gallina and various Anasazi cultures is a result of culture contact and borrowing. It seems possible that the Rosa people, whose culture shows a number of non-Southwestern traits, were migrants who already had crude cooking pots when they reached the borders of the Southwestern area. Coming into contact with the Anasazi of the Basketmaker III period, they copied the painted wares of the latter while retaining their own ware for cooking pots. The Gallina people also may have been migrants with a tradition of cooking pots of the northern type, or may have come into contact with northern migrants, possibly the ancestors of the Navaho, from whom they borrowed this sort of pottery. Conversely, the Anasazi, who originally made little use of cooking pots, may have been stimulated to a more extensive use of food boiling by contact with northern or eastern peoples among whom it was highly developed, and have borrowed certain features of their cooking pottery. Although, if such was the case, these features were soon modified and incorporated into the technically advanced Anasazi pottery complex, their introduction might have established a differentiation between cooking wares and other wares which extended to paste and surface finish as well as form. Thus the Anasazi cooking-pot wares are frequently grit-tempered, a common feature in the northern complex, while their other wares rarely if ever are.

In summary, a study of the variations and distributions of North American cooking-pot forms leads to the following conclusions:

1. That there was no constant linkage in North America between agriculture and pottery making or even between pottery making and settled life. At least one of the basic complexes discussed, the northern, was an integral part of various hunting, food-gathering cultures, and the vessels it produced were structurally and functionally adapted to the needs of nomads. A second, that represented by the early fiber-tempered wares of the southern Atlantic Coast, may also have been pre-agricultural. The actual linkage was not between sedentary life and pottery per se, but between sedentary life and an elaboration of pottery forms and uses.

[8] Huscher and Huscher, 1942.

2. That North American pottery was of heterogeneous origin. The northern complex appears to have been introduced from northeastern Asia and the earliest Southwestern complex from the Mexican plateau. In the Southeast the fiber-tempered wares may be a result of local invention, while the possible influence of the coastal cultures of Middle America on the earliest lower Mississippi Valley wares cannot be ruled out.

3. That pottery need not be primarily an appliance for food boiling and that it may be diffused even when this method of food preparation is of minor importance in the economy of the receiving group. Thus in the development of pottery among the Anasazi the cooking pot seems, at first, to have been incidental. The main stress was laid upon painted wares and shapes having an aesthetic appeal. This is quite in agreement with the frequently observed fact that culture elements which do not involve a change in long-established habits or basic economic techniques are accepted much more readily than those which do.

These general conclusions seem to be supported by abundant evidence. More specific ones as to the relations of particular pottery types to each other and to the basic complexes discussed in this paper are only tentative and need not be summarized here. However, it is hoped that even the general conclusions may emphasize the fact that the purposes for which objects are made and the ways in which they are used are quite as significant for archaeological studies as the objects themselves and provide an equally valuable clue to cultural relationships.

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A BASKETMAKER III SITE IN CANYON LARGO, NEW MEXICO

FRANK C. HIBBEN and HERBERT W. DICK

ONE of the activities of the University of New Mexico's 1939 field school at Chaco Canyon was a reconnaissance excavation in the vicinity of Largo Canyon, to the northeast of the Chaco, proper. This was a continuation of the survey and excavations of the past four seasons, as a part of the project for outlining chronologically and geographically the culture known as Gallina.[1] The extent of the Gallina manifestation to the east and south has already been fairly accurately delineated, but its western and northwestern boundaries are unknown. Since the San Juan and Mesa Verde centers lie to the northwest, it was deemed imperative that the cultural connections in that direction be determined. Typical Gallina unit houses are common on the headwaters of the Largo[2] and in the Llegua Canyon area which heads in the same region. The extremely rugged area lying between this district and the San Juan and Mesa Verde region, however, is not only difficult of access, but is practically unknown archaeologically. The limited amount of previous reconnaissance here suggests Navaho remains of more recent date. As the Gallina cultural complex showed no Chaco influence, the possibility of establishing connections in this direction seemed remote. Abundant similarities and some actual parallels between the Gallina and centers of the San Juan and La Plata, however, gave promise of liaison in the intervening territory. Largo Canyon is crucial in this respect. Access to this region is possible, but not easy, from the direction of Chaco Canyon.

Several significant centers in the lower reaches of Largo, Blanco, and Compañero canyons were examined at the suggestion of Mr. Richard Van Valkenburg, unquestionably the person most familiar with this section of the country through his studies of Navaho nomenclature. These sites fall into three general classes. The first class consists of depressions marking the sites of former pit houses, near which there are large areas covered with sherds of unslipped rough gray ware. The second class, representatives of which were not numerous, is made up of small masonry ruins, obviously affiliated with the Chaco centers. The third, and obviously latest class of remains in this region, is that which includes several categories of ruins of Navaho origin.[3]

The site chosen for excavation belongs in the first group, that in-

[1] Hibben, 1938, pp. 131–136.

[2] Mera, 1938, pp. 236–243.

[3] Farmer, N. D.

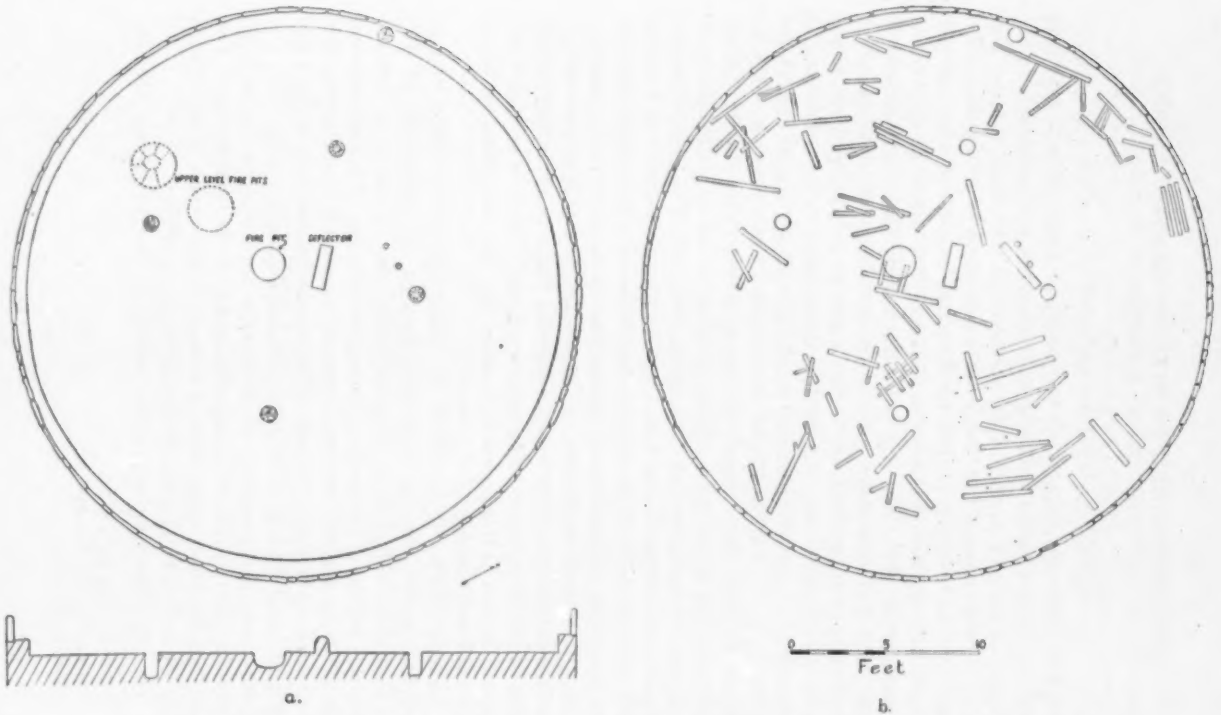


FIG. 29.—Basketmaker III pit house in Canyon Largo. *a*, floor plan and cross-section; *b*, arrangement of roof timbers.

cluding pit house depressions. It lies at the junction of Blanco and Largo canyons, on a high terrace above the bottoms of both canyons known as Salt Point, or *Ashi'ina'áá*, by the Navahos of the region, and associated with one of the so-called primal clans. The whole point, comprising an area of 100 acres or more, is covered with sherds of the granular gray variety obviously affiliated with Basketmaker III cultures. The pit-house depressions, three in number, lie toward the Largo, or northern, side of Salt Point. Near them are some areas covered by sherds and some rectangular slab-lined cists. The periphery of the largest depression was bordered by a complete line of vertical stone slabs in a manner reminiscent of Shabik'eshchee village.[4] Because of its size and because it promised to yield the greatest number of sherds, this one pit house was selected for excavation. A factor which greatly influenced the decision in favor of excavating this site was the similarity of certain forms of sherds found on the surface to those of the Gallina. No Gallina sherds of the classic type occur here, but forms of lugs and outlines of rims are remarkably suggestive. Furthermore, pit houses are an outstanding feature of the Gallina architectural sequence.[5]

Figure 29, *a* shows the salient features of this pit house. The house was circular, with a banquette extending completely around the circumference, and with a four-post support (Pl. XXXIV, *a*). It was not deeply excavated below the ground level, the lower floor being only two feet beneath the surface. Interior features consisted of a fire pit, a screen to the north of the center of the house, and two adjacent post-holes, which were possibly holes for a loom or the butt of the central ladder. The floor of the house and the banquette were of a hard-packed, burned adobe.

One of the outstanding features of the pit house at Salt Point was its two floors. The upper floor, which lay only eight inches beneath the present ground surface, was rough, but hard-packed. It overlay the charred beams of the fallen roof of the original dwelling and was equipped with two fire pits lined with stone slabs (Pl. XXXIV, *b*). No house supports were visible. Although the pottery sequences were somewhat mixed in the upper level, the abundance of wares referable to the Navahos almost certainly indicates occupation of this later structure by that people. Gobernador Polychrome, Punyame, and Navaho utility ware represented 60 per cent of the sherds in the fill above the upper floor. Mr. Van Valkenburg has suggested that the Navahos often lived on ancient sites, where they found it convenient to do so.

The remains of the charred beams which lay in place on the lower,

[4] Roberts, 1929, Pls. 2, *a*; 9, *a*.
[5] Hibben, 1938, p. 132.

or original, floor were of some assistance in determining the roof construction of this building. Figure 29, *b* shows that the beams, although they lay in all directions, did suggest a pattern. The occurrence of several large forked posts around the periphery of the house, near the banquette, should be noted. Apparently the entrance was through the roof.

Potsherds, as well as some other artifacts, occurred in relative abundance on the floor of this structure. Despite the fact that no whole pottery pieces were recovered, although the structure had been burned, the shapes of vessels are apparent. The pottery of the Largo Canyon area is definitely affiliated with the La Plata, Mancos, and Shabik'eshchee wares of adjoining areas.[6] The ware consists of a light gray, hard paste, with a coarse quartz sand temper, which protrudes above both the interior and exterior surfaces of the vessel. The surface is scraped, apparently with the hand, and smear marks are characteristic. The ware does not differ radically in appearance from Lino Gray ware. Vessel shapes include large, narrow-necked ollas with side lugs, seed jars, narrow-necked bulbous pitchers, and plain-rimmed open bowls. These vessels were constructed by the coil-building method, and, at least occasionally, the coils are left unobliterated in the neck region. Impressions of basketry are not uncommon on the exteriors.

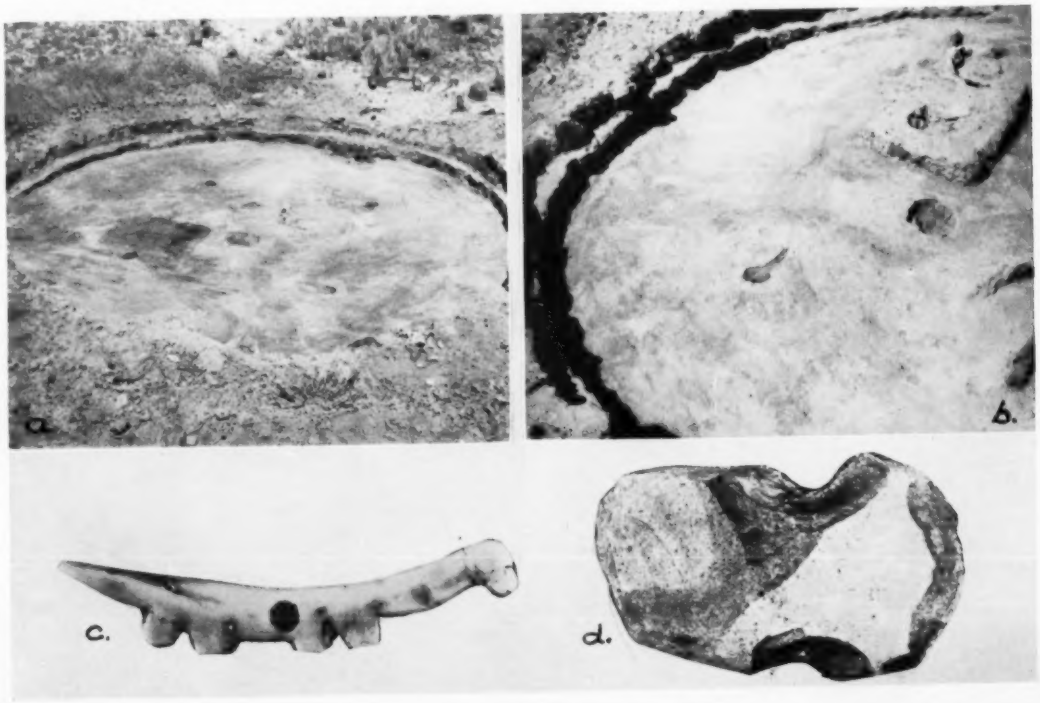
A painted variety of this pottery also occurs, but is greatly in the minority. Approximately one out of every fifty sherds has a painted decoration in black on an unprepared background. The designs are simple and are rather crudely done, consisting of five-pointed stars of multiple lines with adjacent dots in bowl bottoms. A single sherd of black-on-red pottery occurred on the floor. This is of the type reported by Morris to occur in Basketmaker III levels. All of this pottery may be definitely referred to the Basketmaker III horizon as recently reviewed by Morris.[7] The similarity in form between the lugs and rims of vessels from Salt Point and those of the Gallina district did not, as had been hoped, increase with continued excavation. It was found, however, that the Gallina and the Salt Point material share a common similarity to that of the La Plata district of Colorado, a similarity which is impressive in the Gallina because of the relative isolation of this culture.

Artifacts other than pottery in the Salt Point pit house were few. Metates are of the trough variety and the manos are relatively short, of the class usually designated as one-handed. Stone axes, the next most

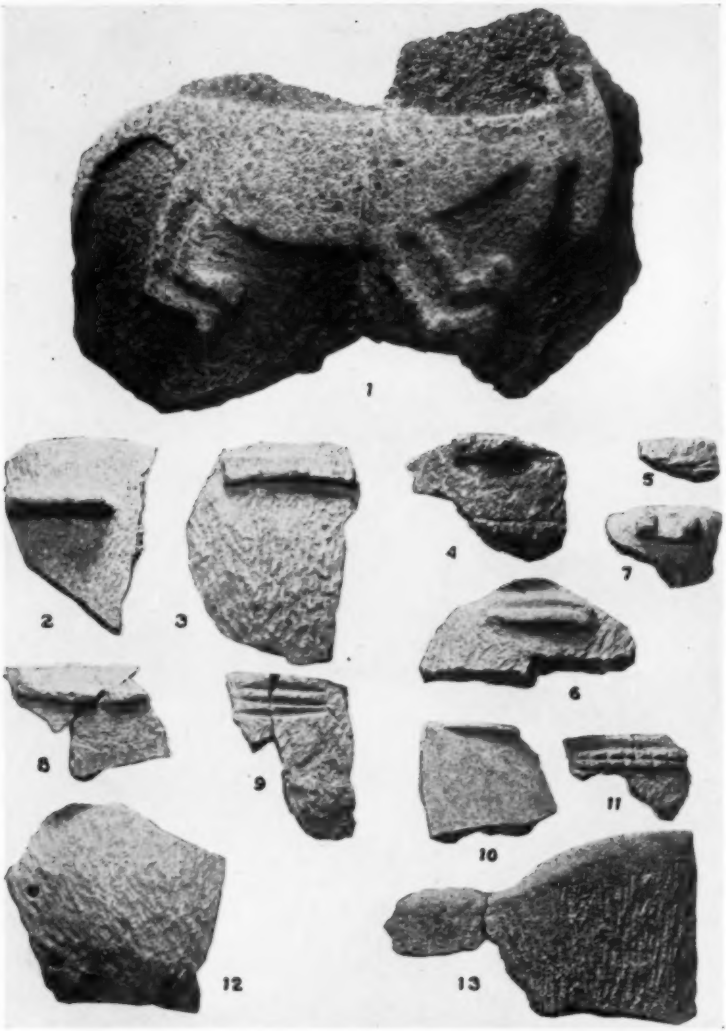
[6] This has been called Rosa because of the abundance of this ware among the numerous pit-house depressions in the vicinity of the small town of Santa Rosa, north and east of Salt Point. See Mera, 1935, p. 2.

[7] Morris, 1939, pp. 143–157.

[HIBBEN AND DICK] PLATE XXXIV
AMERICAN ANTIQUITY, VOL. IX



Largo Canyon pit house and artifacts. *a*, large pit house showing four post plan with central fire place and banquette; *b*, segment of Largo pit house with a portion of the upper floor containing two fire pits still in place; *c*, shell ornament from lower floor of pit house (slightly less than twice natural size); *d*, stone axe from lower floor of pit house (slightly less than one-third natural size).



Stone vessels, Poverty Point site. *1*, embossed animal design (courtesy Judge H. J. Lemley); *2–11*, types of lugs; *12*, perforations along two margins of sherd; *13*, segment of rim showing irregular shape and beveling of rim.

numerous of the artifacts, are made of river pebbles, crudely notched and sharpened by rudimentary chipping at the bit (Pl. XXXIV, *d*). Hammerstones of various shapes are numerous, as are a large variety of quartzite boulders whose use is not certain. Hammerstones and boulders both show shaping as the result of use rather than in accordance with any preconceived outline. Outstanding among the artifacts is a small shell pendant (Pl. XXXIV, *c*) simulating the outline of an animal. This is made from the lip of the *Glycimerus* shell. Projectile points are not numerous, and those recovered are all surface finds. These points are all of the three-quarter notched variety with relatively long tangs and barbs.

Although none of the timbers recovered were datable, the aggregate of the material culture, the structural plan, and the ceramic types definitely places this structure in the Baskermaker III horizon. Divergences from the characteristic Basketmaker III houses of the Chaco region as well as from those of the La Plata district are minute. Connections with the Gallina are tenuous and are certainly no stronger than those between the Gallina and the La Plata. The form of the Salt Point house, surrounded as it is by stone slabs, would seem to place it in a class by itself, since all of the other pit-house depressions in this region (and there are many up and down the Largo and Gobernador canyons) lack this addition to the periphery. The Salt Point building has much in common with the kiva structures noted by Roberts at Shabik'eshchee[8] and also by Morris in the La Plata.[9] It may undoubtedly be referred to this group and be designated a kiva or protokiva.

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June, 1942

[8] Roberts, 1929, pp. 73–81. [9] Morris, 1939, pp. 82–84.

STONE VESSELS FROM A NORTHEAST LOUISIANA SITE

CLARENCE H. WEBB

HOLMES[1] states that steatite was widely used by the Indian tribes north of Mexico for the manufacture of implements, ornaments and utensils. The manufacture of stone vessels predominated on the Pacific coast, especially in the Santa Barbara region where sites have stone vessel fragments in all strata, and along the Atlantic coast, where this trait was especially associated with the Old Algonkian culture of the North Atlantic.[2] The use of stone vessels in the areas in which pottery was used, both in the Mississippi Valley and the Southeast, although much less common, is indicated by occasional references to vessels or fragments on various sites and by the presence of quarries such as those described by Jones[3] in the Tallapoosa River region of Alabama. The comparative infrequency of these artifacts on sites in the lower Mississippi Valley inspired the preparation of this report of a large cache of fragments of stone vessels found on a site in West Carroll Parish in northeastern Louisiana.

The Poverty Point plantation, with the adjoining Jackson or Neal place, is one of a large series of mound sites situated on the west bank of Bayou Maçon, on the first high ridge west of the Mississippi River. It has been described by Moore,[4] Fowke[5] and Ford.[6] Moore called attention to the paucity of pottery sherds in comparison with the wealth of other artifacts and conjectured that stone vessels were used, since occasional steatite fragments were found.

Ford[7] classified the pottery from the contiguous Neal (or Jackson) place as predominantly Marksville and Coles Creek. These sherds occur in a limited area near the stream and a few similar sherds may be found also in a limited area of the Poverty Point site, especially around two small mounds. Farther up Bayou Maçon, in Arkansas, Dickinson and Lemley[8] found Marksville and Deasonville sherds on several sites, but no steatite fragments. However, at the Kirkham mound, on the Little Missouri River in south central Arkansas,[9] a limestone vessel fragment was found in association with Marksville and Coles Creek sherds, and Lemley[10] reports that a steatite vessel was plowed up near Ozan, in southwestern Arkansas.

Other artifacts found in large numbers at the Poverty Point site include plummets of hematite or other stone, of which a cache of fifty-

[1] Holmes, 1912, p. 635.
[2] Jones, 1939, pp. 12–18.
[3] Wissler, 1938, pp. 265–283.
[4] Moore, 1913, pp. 64–76.
[5] Fowke, 1928, pp. 434–436.
[6] Ford, 1936, pp. 213–216.
[7] Ford, 1936, *loc. cit.*
[8] Lemley and Dickinson, 1937.
[9] Dickinson and Lemley, 1939.
[10] Lemley, Personal communication, 1942.

one was found on one occasion; beads of red jasper and other stone materials, often carved as bird effigies; crinoid stem beads; innumerable masses of the peculiar baked clay balls described by Moore;[11] large blades and points of several types, usually stemmed, with a few minute points which are usually found in the areas where pottery sherds appear; well finished large drills and many small crude drills; and large scrapers, some keel-backed, others triangular or ovate. Less numerous are human figurines of pottery; polished stone tablets or gorgets, usually two-holed; tubular or conical pipes and cylinders, either of steatite or clay; grooved axes; and ungrooved celts.

Ford *et al.*[12] have found baked clay balls, plummets, tubular pottery pipes and one fragment of a steatite vessel in Tchefuncte sites of southern Louisiana, but as yet no Tchefuncte pottery sherds have been identified from the Poverty Point or Neal sites.

Webb and DeJarnette[13] describe steatite and sandstone vessels and fragments found in the pre-pottery levels of three shell-mound sites in the Pickwick Basin area of the Tennessee River, in northern Alabama. Fragments of a large steatite vessel were found broken over a burial at one site. When restored, the vessel was 13.5 inches in outside diameter, 8.25 inches deep and had walls 0.75 inch thick. At a second site, an infant was buried in a large sandstone bowl. At each site there was evidence of a long occupation period before the advent of the stone vessels, which in turn clearly antedated clay pottery usage.

Other traits of these non-pottery dwellers of the shell mounds included atlatl weights (bannerstones and boatstones), bell pestles, mortars and nutstones, cylindrical and barrel-shaped beads, circular hammerstones, grooved axes, two-holed stone gorgets, tubular stone pipes, unnotched ovate flint blades, long projectile points, and flint drills. It is interesting to note a number of similarities to the Poverty Point traits.

Fowke[14] quotes a resident of the Poverty Point plantation as describing a huge steatite vessel which was struck by the plow in 1925. The fragments of this vessel were stated to weigh sixteen pounds. In 1935 this individual took a friend and me to the field where this vessel was encountered. It is about one-fourth mile southwest of Moore's[15] Mound A, which Fowke[16] considered to be a natural hill. Artifacts are to be found in the fields surrounding this eminence and between it and Bayou Maçon, a distance of one-half mile.

In the field pointed out to us, fragments of stone vessels were found scattered over an area about thirty meters square, with occasional pieces

[11] Moore, 1913, pp. 64–76.
[12] Ford *et al.*, N. D.
[13] Webb and DeJarnette, 1942.
[14] Fowke, 1928, pp. 434–436.
[15] Moore, 1913, pp. 64–76.
[16] Fowke, *op. cit.*

over the entire field of several acres. Subsequent trenching where the fragments were most numerous disclosed a pit, irregularly oval and approximately 2.5 by 2 meters in diameter and 60 cm. deep, with almost vertical walls, cut into the yellow clay of the field. A small portion of the pit was disturbed, where it had been dug into when first discovered in 1925, and very few fragments were found in the refill. The remaining, undisturbed portion of the pit was filled with masses of stone vessel fragments varying from 2 cm. in diameter to one-third of a vessel's circumference. These fragments were removed in groups and kept separate for distributional studies. After the specimens were cleaned, it was found that in several instances portions of a vessel had been taken from widely separated parts of the pit, indicating that the vessels had been broken and their parts mixed before placement in the pit. The fragments extended into the cultivated soil, and the distribution of the pieces found on the surface indicated that they had been scattered from the upper levels of the cache during the ten years of cultivation.

The level floor of the cache pit was fire-blackened in four areas, 30–60 cm. in diameter, one of which had a bed of ashes and charcoal, 10 cm. thick, suggesting some ceremony preceding deposition of the vessel fragments. Examination of the pit walls showed no evidence of any floor level of a house, and excavation well below the floor of the pit showed undisturbed clay. Careful troweling of the soil during the removal of the fragments produced only two other artifacts, a chert flake and a rough scraper, which may have been accidental inclusions.

A total of 2,205 fragments was removed from the pit and 519 were gathered from the surface or troweled from the cultivated soil within a radius of 10–15 meters. Undoubtedly other hundreds have been taken away or scattered through the fields since the discovery of the cache.

Through the kindness of Dr. Fred B. Kniffen, of the Louisiana State University School of Geology, gross identifications of sample specimens were made by Dr. Russell and Dr. Fisk of the Geology staff. They state that thorough identification of the complex mineral composition could be made only by microscopic study of thin sections, which the press of university work prevented. "They all appear to be members of a series of schists, sufficiently alike that they might all have come out of the same outcrop." The dominant minerals in the various specimens submitted are identified as follows: talc schist, hornblende-mica schist, biotite schist, actinolite-chlorite schist, and tremolite schist, all of which Dr. Russell believes are derived from igneous rocks; and mica gneiss, muscovite-biotite mica schist, fine-grained muscovite quartz schist, garnet-mica schist and garnet-muscovite schist, which are regarded as derived from sediments. Dr. Fisk suggests, because of the

presence of the garnet, that these materials came from the southern Appalachians, or, less probably, from the Lake Superior region.

Comparison of the identified specimens with the entire group of fragments shows that the majority of the vessels were made from the first group of materials, especially the combinations of actinolite, chlorite, biotite and tremolite, with smaller numbers from the talc and hornblende-mica schists and only occasional specimens from the second group of schists derived from sediments.

The larger fragments indicate that nearly all of the vessels were open bowls, irregularly circular or oval in shape, with outside walls convex from top to bottom. Some have almost straight side walls (Fig. 30, *1–6*). One or two show incurving rims, producing the "olla type" interior or closed bowl (Fig. 30, *7*), while Fig. 30, *8* suggests a shallow platter.

The evidence indicates that the dimensions of the vessels range as follows: height, 7.5–18 cm.; width at the rim, 20–28 cm.; thickness of side walls, 8–25 mm.; average thickness 14–15 mm.

Gouge marks are present on most fragments. On the outer surfaces, these are usually vertical, but occasionally diagonal; they are more frequently diagonal on the inner surfaces. The inner surfaces are often partially or completely smoothed, the grinding marks being horizontal. One hundred and eighty-eight fragments are quite smooth on both surfaces, and in some instances the surfaces are well polished.

One almost complete vessel (Fig. 30, *16*) is an open bowl with sides of unequal height. The greatest diameter of its oval mouth is 28 cm. Its exterior is roughened by gouge marks; its interior, partially smoothed, and the rim is rounded. Two perforations on one side are spaced 2.5 cm. from the rim and 1 cm. on either side of a major fracture line.

A second vessel (Fig. 30, *17*) is represented by sufficient portions to give its dimensions and shape. Also an open bowl, it has sides of unequal height, averaging 18 cm. The base is circular and flat. The walls are uncurved vertically except at the rim, which curves inward to produce a thinned lip. The circular opening is 28 cm. in diameter. All surfaces of the vessel are ground quite smooth.

Four hundred and ninety-two fragments show segments of rim and, although many duplications are evident, at least two to three hundred separate vessels are represented.

Most of the rims have rounded lips (Fig. 30, *2*, *3*, *6–9*) and are sometimes thinned by beveling of the outer wall. In other instances the lip is flattened (Fig. 30, *1*, *4*). Several portions of one vessel (Fig. 30, *5*) have a rim which is thicker than the subjacent wall, with flat, outward-sloping lip. The rim and a space of several centimeters below it on the outer wall of some vessels with rough surfaces is smoothly ground.

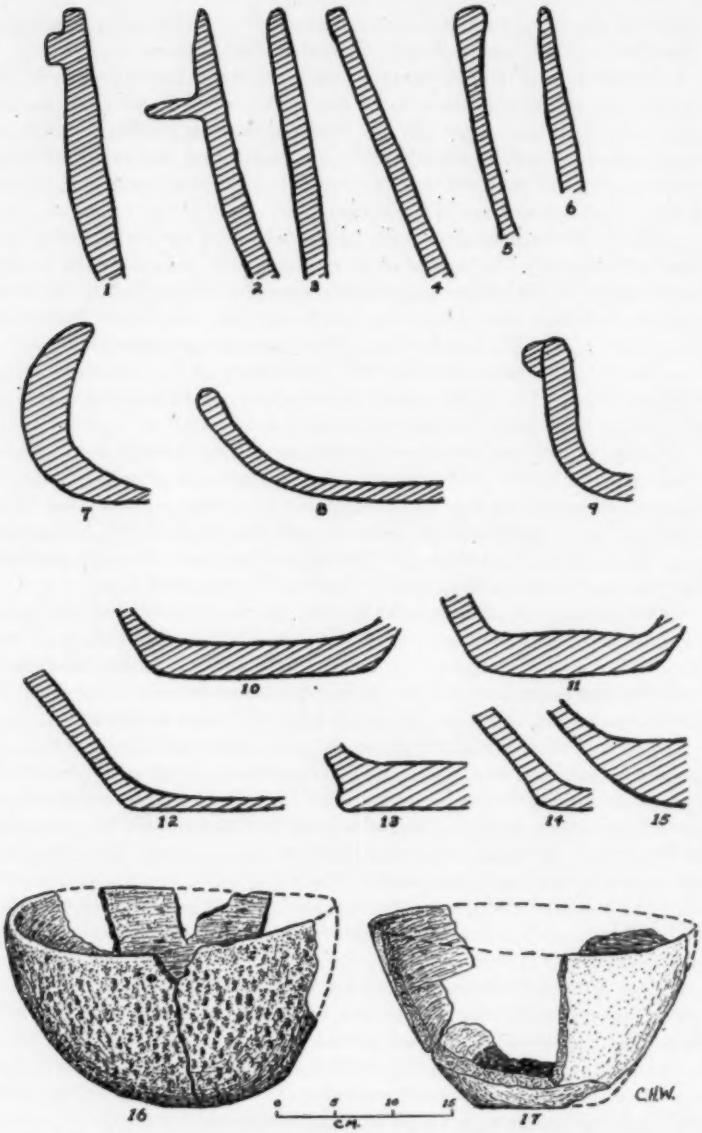

FIG. 30.—Stone vessels, Poverty Point site. *1–9*, rim and side-wall profiles; *10–15*, sections through bases; *16*, *17*, vessel shapes.

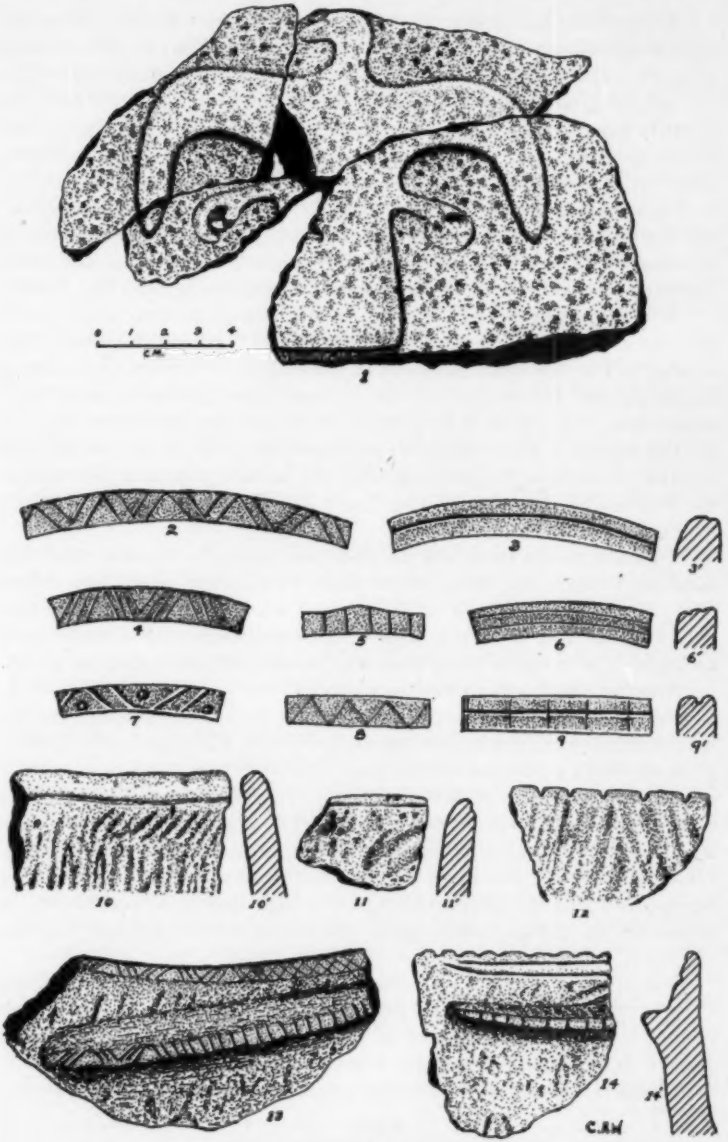

FIG. 31.—Stone vessels, Poverty Point site. *1*, embossed eagle design; *2–12*, lip and rim decorations; *13*, *14*, lip and lug decorations.

Decorations are present on fifty-two of the rim segments. The simplest decoration consists of a single groove outside (Fig. 31, *10*) or inside (Fig. 31, *11*) the rim. In other instances the thinned lip is notched (Fig. 31, *12*), or grooves and notches are combined (Fig. 31, *14*). More frequently the decoration appears on a flattened lip, as channeling by one or two grooves (Fig. 31, *3*, *6*), as transverse lines (Fig. 31, *5*), as a combination of these (Fig. 31, *9*) or as various combinations of single- or multiple-line zig-zags or chevrons (Fig. 31, *2*, *4*, *8*). Two fragments from the same vessel have a combination of double-line chevrons with circular depressions (Fig. 31, *7*). Another large piece has chevrons and cross hatching on the lip, with chevrons and notching on the lug (Fig. 31, *13*).

It is interesting to note that several of these decorative elements are present in potteries of the lower Mississippi Valley. Thickened rims similar to Fig. 30, *5*, are frequent in the Coles Creek pottery of central Louisiana and Mississippi and the flattened lip with one- or two-groove channeling (Fig. 31, *3*, *6*, *9*) is listed by Ford[17] as a characteristic type for this complex. The notched or scalloped lips (Fig. 31, *12*, *14*) and the interior rim incising or grooving (Fig. 31, *11*) are prominent features of the Haynes Bluff pottery of the Yazoo Valley which has been ascribed by Ford[18] to the Tunicas.

Two fragments from the pit and two from the surface collection combine to form the figure of an eagle with spread wings and talons (Fig. 31, *1*). The figure in relief is raised about 2 mm. above the surrounding surface, is 12 cm. wide and 10 cm. high and is quite symmetrical. The vessel is made from a glistening actinolite-chlorite schist.

Another effigy is described here through the courtesy of Judge H. J. Lemley of Hope, Arkansas, who secured it from Mr. Autenberry, the local resident who plowed into the cache in 1925. This figure (Pl. XXXV, *1*) is similarly embossed on the same type of stone, and represents a queer animal which in some respects resembles a panther, and in other features suggests a mountain goat. The primitive artist may have had some mythological creature in mind, since the craftsmanship exhibited in carving the eagle and the exquisite carvings of bird effigy beads from this site give evidence of a high degree of proficiency in stone carving. Judge Lemley gives the length of this figure as 9 inches (23 cm.), its height as 3½ inches (9.9 cm.).

One hundred and five fragments have lugs or portions thereof, which vary considerably in size and position (Pl. XXXV, *2–11*). Some were created by a local thickening of the rim, but more often they were placed 1–6 cm. from the lip. They vary from 1–20 cm. in length, from 1–4 cm. in thickness and project from the vessel wall an average of 1–3 cm.,

[17] Ford, 1936, pp. 213–216. [18] *Ibid.*

although extremes of 5 mm.–6 cm. are present. The upper surface of the lug is usually horizontal, while the lower surface frequently slopes downward to join the wall at an obtuse angle.

Vessels with smoothed outer surfaces usually have smooth lugs and vice versa. A few of the lugs are decorated with notches (Fig. 31, *14*), nodes (Pl. XXXV, *7*), or lines placed diagonally or transversely (Fig. 31, *13*). Several have deep longitudinal grooves (Pl. XXXV, *9*) and one had combined longitudinal and vertical grooving (Pl. XXXV, *11*).

Twenty-nine fragments are perforated and some of them are broken through the holes. Seven rim segments have perforations near the rim, while one wall fragment has four holes placed around two margins (Pl. XXXV, *12*) and another is perforated near the base. The holes are sometimes counter-drilled, sometimes drilled altogether from the outside. Their placement suggests that they were made for purposes of repair, rather than for suspension. In no instance are opposed perforations found; none occurs near the rim away from a fracture.

Portions of bases are found on 105 fragments, and two complete bases are present. They are circular or irregularly oval, 10–20 cm. in diameter, and nearly always flat or partially flattened on the bottom surface. Several types are shown in Fig. 30, *7–15*. The average thickness is 1.5–2 cm., with variations from 5 mm. to 4 cm. Some of the bases seem to have been ground or worn practically through before breaking. The inside surface is usually concave, but occasionally is convex (Fig. 30, *11*) and often is flat, paralleling the bottom surface (Fig. 30, *10*, *12*, *13*).

The expanse of this site and its richness in residual artifacts indicate that it was extensively occupied for a long time. One conjectures that the stone vessels were used during a pre-pottery era, possibly antecedent to or coeval with the Tchefuncte culture of southern Louisiana, in which some of the Poverty Point traits (baked clay balls, plummets, tubular pipes, steatite) appear. If so, this stone vessel era was followed by the Marksville and Coles Creek cultures, sherds from which are found over a limited area near the stream.

This suggested sequence at Poverty Point is strengthened by comparison with the recently described shell-mound excavations in the Pickwick Basin,[19] where stone vessels appeared in the pre-pottery levels, along with such traits as tubular pipes, cylindrical and barrel-shaped stone beads, 2-holed stone gorgets, flint drills, unnotched ovate blades and long projectile points. Webb and DeJarnette consider these points to have been used exclusively for atlatl projectile points, especially since atlatl weights and hooks are present, and consider the bow and arrow to have been used only in the late occupational era, when small projectile

[19] Webb and DeJarnette, 1942.

points appear along with clay pottery. Many of the large points at the Poverty Point site may also have been made for use with the atlatl, although definite proof must await adequate excavations.

Whatever the sequences, which remain to be established by careful excavations or collateral evidence, it seems likely that the major portion of the Poverty Point site was occupied by a people who made little or no pottery but used stone vessels. It would appear further that they had a custom of caching worn out or broken vessels, probably with some attendant ceremony, or that some major change in their life—a cultural shift to the use of pottery, the necessity of moving suddenly, or some ceremonial custom—impelled them to break and dispose of the stone vessels. The reports of other finds of caches by the present residents increases the supposition that placement in caches was a prevalent custom.

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ARTIFACT TRANSPORT BY MIGRATORY ANIMALS AND OTHER MEANS

ROBERT F. HEIZER

TWO recent papers, one by Arthur Woodward,[1] the other by J. Alden Mason,[2] have called attention to the transportation of artifacts by the process of animal migrations. The impulse for both of these works derived from the finding of an Eskimo arrowhead imbedded in the breast of a duck shot at Bakersfield, California.[3] Similar cases from the states of Indiana, North Carolina, and Nebraska are on record in these reports. Undoubtedly there are other known instances, but these four should serve to illustrate the fact that sizeable migrating birds may import projectiles of outland origin from tremendous distances.

I should like to present some additional instances which have come to my attention. These deal chiefly with transport of artifacts by migrating sea mammals and fish. The larger sea mammals are peculiarly suited to carrying weapon points, since they have a thick protective fat covering in which a projectile could remain imbedded without having a harmful or hindering effect on the animal's health or movement. Whales, the largest animals on earth, have wide-ranging habits and a pan-oceanic distribution. It is to be expected, as Mason points out, that whales should be noted for carrying in their bodies the weapons of unsuccessful hunters. Records are numerous, and I cite a few of them here. Otto von Kotzebue[4] notes that in 1653 Hendrick Hamel found European harpoons sticking in whales taken off the coast of Korea, and that again in 1716 a similar discovery was made by Henry Busch off the coast of Kamchatka.[5] Scoresby says, "Whales, which have been harpooned in the Greenland seas, have been found in the Pacific Ocean; and whales with stone lances sticking in their fat (a kind of weapon used by no nation now known) have been caught both in the sea of Spitzbergen and in Davis's Strait."[6] Scoresby cites a number of instances of whales which had been killed by Europeans and which were found to have harpoons and stone and bone lances imbedded in their tissues.[7] His illustration (Vol. 2, Pl. 2) of a polished leaf-shaped lance blade fastened

[1] Woodward, 1941, pp. 13–15.

[2] J. A. Mason, 1934, pp. 314–315.

[3] Also reported in *Science News Letter*, 1934.

[4] Von Kotzebue, 1821, Vol. 3, p. 267. See also Charlevoix, 1736, Vol. 6, pp. 51–52, 398; Dall, 1899, pp. 136–137.

[5] A similar Kamchatkan occurrence is mentioned in Steller, 1774, p. 102.

[6] Scoresby, 1820, Vol. 1, p. 8. O. T. Mason, 1902, Fig. 27, p. 264, reports a similar case of a whale caught in Cumberland Sound in 1878. The harpoon is shown in Fig. 32, *b* of this paper.

[7] *Ibid.*, pp. 8–12.

to a socketed bone haft, which was found under these circumstances by a Hull whaler near Greenland, is reproduced here as Fig. 32, *a*.

William H. Dall[8] excavated a single, barbed, polished slate whaling lance blade from a site on Unalaska Island. Since this type of point is atypical for the Aleutian Islands, we may be on fairly safe ground in suggesting that this specimen found by Dall came from a whale which was struck near Kodiak Island, but which drifted ashore on Unalaska. This possibility is enhanced by the fact that Holmberg[9] mentions

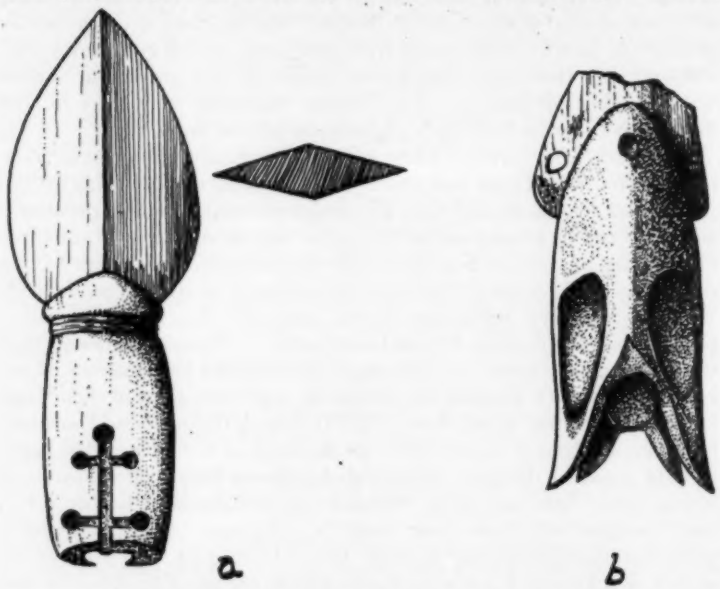

FIG. 32.—Eskimo harpoon points recovered from the bodies of dead whales. *a*, after Scoresby; *b*, after Mason (*Drawings by A. Treganza*).

whales killed at Kodiak which were cast ashore on Unalaska. Von Wrangell said, "In the summer of 1831 there were 118 whales wounded [i.e. struck] at Kodiak, of which only 43 found their way to shore." Some of these lost whales may have carried the killing points to far-off strands.[10]

[8] Dall, 1877, figure opposite p. 75. The polished slate lance blade is characteristic of Kodiak Island and the adjoining mainland area, but not of the islands west of the Alaska Peninsula.

[9] Holmberg, 1885, p. 110.

[10] See also Bodfish, 1936, p. 215, for mention of stone and native copper whaling

O. J. Murie cites other evidence that sea mammals may transport imbedded weapons from their faraway points of origin. He says, " . . . sea mammals with harpoons and spears of a type not used on St. Lawrence Island or Siberia occasionally are found awash on the beach [at St. Lawrence Island]. Such exotic relics are used by the Eskimo as charms and they will not show them to anyone."[11]

Seals have also been found with weapon points imbedded in the flesh. The only certain instance which has come to my attention was reported by George Davidson in 1870. He describes a male seal which was shot at Point Arena on the California coast north of San Francisco Bay and which had an "Alaskan spearhead" (harpoon?) imbedded in the body with part of the sinew line still attached.[12] In 1940, while excavating a shell mound at Drake's Bay about thirty miles north of San Francisco Bay, we recovered the central portion of a heavy, unilaterally barbed bone harpoon head. The type is unreported for the area and, in view of its atypical nature and the abundance of sea mammal bones in the site, it seems probable that the point was introduced to our area and site by a migrating sea mammal. The harpoon is most similar to those recovered by L. L. Loud at Humbolt Bay,[13] some 200 miles to the north.

Even live fish may carry artifacts in their bodies. For example, a metal knife was found in the body of a fish at Gloucester, Massachusetts.[14] I know of no instances of fish disseminating fishhooks by these means, yet the possibility is not as remote as it might seem at first glance. Here one might postulate an origin for the Oceanian-like shell fishhooks of the Santa Barbara Channel region of California.[15]

As Woodward and Mason point out, migrating land mammals might transport projectile points imbedded in their flesh or bones from one area to another. From archaeological sites in the Sacramento Valley have come numerous bones of deer or tule elk with flint and obsidian points firmly stuck in them. The points are, however, local types, which would indicate simply that the animal had been wounded in the immediate region. Woodward, in discussing this type of find, says, "This factor,

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harpoon heads found in whales. *Life Magazine* (October 17, 1938) reports a harpoon stamped with "Chinese characters"(!) found in a wounded whale washed ashore on Lewis Island (Hebrides).

[11] Murie, 1936, p. 346. Collins, 1941, Fig. 7, pp. 323–324, reports an atypical harpoon head which may be an outland form introduced by special means such as those under discussion here.

[12] California Academy of Sciences, 1873, p. 132.

[13] Loud, 1918, Pl. 21, Fig. 3.

[14] Gudger, 1922, pp. 452–457.

[15] Robinson, 1942.

I believe, should definitely be taken into consideration when seeking an answer to the sporadic discoveries of the Folsom type points which have been reported in different, widely separated areas, unaccompanied by definite camp sites directly attributed to Folsom man."[16]

These few examples may be considered as illustrative of a process of "diffusion" which has been, until recently, little emphasized. The significance of the problems raised by finding an Eskimo bone arrowhead thousands of miles away from its point of origin indicates how important it is that this type of non-human dissemination should be kept in mind and tested when there seems warrant. This specialized method of transmission of portable material culture forms might be called "thero-portation," or "migratory animal artifact portation." Theoretically, a strange type of projectile point found imbedded in the body of a slain animal might furnish the pattern and stimulus for an established, local form. Here, at least, is a test which might be applied to certain discontinuous artifact type distributions. Some material forms, such as harpoons, arrow points, or lance points, used by coastal sea-mammal hunters might spread widely by these means.

It is to be desired that further data on this subject be made available. Archaeologists may only rarely find "thero-portation" a useful tool to explain some otherwise puzzling occurrence, but in these rare instances the explanation will be valuable. In each case knowledge of the exact type of artifact, the material from which it is made, and its chronological position in its homeland (point of origin) will be of aid in settling the problem. The archaeologist should consult specialists on the migrating habits of the animal to which the introduction is attributed or which is suspected of being responsible.

It must be pointed out, however, that there are numerous other means of dispersal of artifacts over long distances which present special problems. For example, Rickard[17] has developed the idea that the Indians of the Northwest Pacific coast got and used iron from drift wreckage in pre-Caucasian times. Further, but not exhaustive, data on this interesting type of transmission will be found in the papers of Brooks[18] and Stokes.[19] Then there are the unusual, and often unheralded, introductions of cultural forms from great distances through the agency of early explorers or traders. Instances are numerous, and I cite as illustra-

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[16] Woodward, 1941, p. 15.
[17] Rickard, 1939.
[18] Brooks, 1876.
[19] Stokes, 1934.

tions the Santa Barbara spear-thrower,[20] Monterey shells on the Northwest Coast,[21] and Japanese raincoats in Mexico.[22]

Cultural historians should make note of these various unusual processes of artifact dissemination. By their rarity they achieve importance and significance.

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THE CLOVIS SITE: REGIONAL PHYSIOGRAPHY AND GEOLOGY

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THE geology of the Clovis site cannot be fully understood from examination of the immediate surroundings. While the studies published by the investigators who have been excavating the vertebrate fossils and human artifacts have contributed much to an understanding of the locality,[1] there are important items in the regional physiography and geology which have not heretofore been described in print. The writer has for several years been attempting to complete a manuscript on the Llano Estacado, its cap rock, and similar cap rocks of the world. This study is now essentially completed and the manuscript will, it is hoped, be submitted to a geological periodical in the near future. For the guidance of archaeologists, this short outline of salient features bearing on the Clovis locale is offered in advance of fuller demonstration.

The surface of the southernmost element of the High Plains plateaus —the Llano Estacado—is marked by two types of solution depressions: cap rock karst basins not more than three miles wide and about fifty feet deep, and great "slump basins" and "slump troughs," as the writer terms them. The latter are similar to, but smaller than, the Pecos trough—not "valley." The Portales trough is one of these. It is a depression of irregular shape, valley-like in places, but swelling to a basin thirty miles in width along the meridian of Clovis and Portales, New Mexico. It is approximately 150 feet deep near Portales and vanishes to the eastward at about the meridian of Plainview, Texas (Fig. 33). This and similar troughs are believed to have been caused by deep-seated, slow solution and settling, or collapse, in the thick limestones and saline residues which lie beneath the Tertiary of the plateau.[2]

Through and across the present area of the Portales trough and its associated modern drainage system of intermittent arroyos there have run streams which, in times of pluvial climates, have deposited beds of gravel. Such an ancient drainage line runs, at a high level today, across the Enoch[3] lake basin in southeastern Bailey County, Texas. This small stream valley is visible in the topography and is cut by the lake basin so that it forms a hanging valley. It once drained toward Silver Lake in northwestern Cochran County, Texas. There is no topographic evidence of a valley of any size on the plateau eastward from the Portales

[1] Howard, 1939, gives a nearly complete bibliography. See also Sellards, 1940.

[2] Morgan, Frye and Schoff, addresses presented to Section E, American Association for the Advancement of Science, Dallas, Texas, 1941, unpublished.

[3] Name assigned here. No local name found.

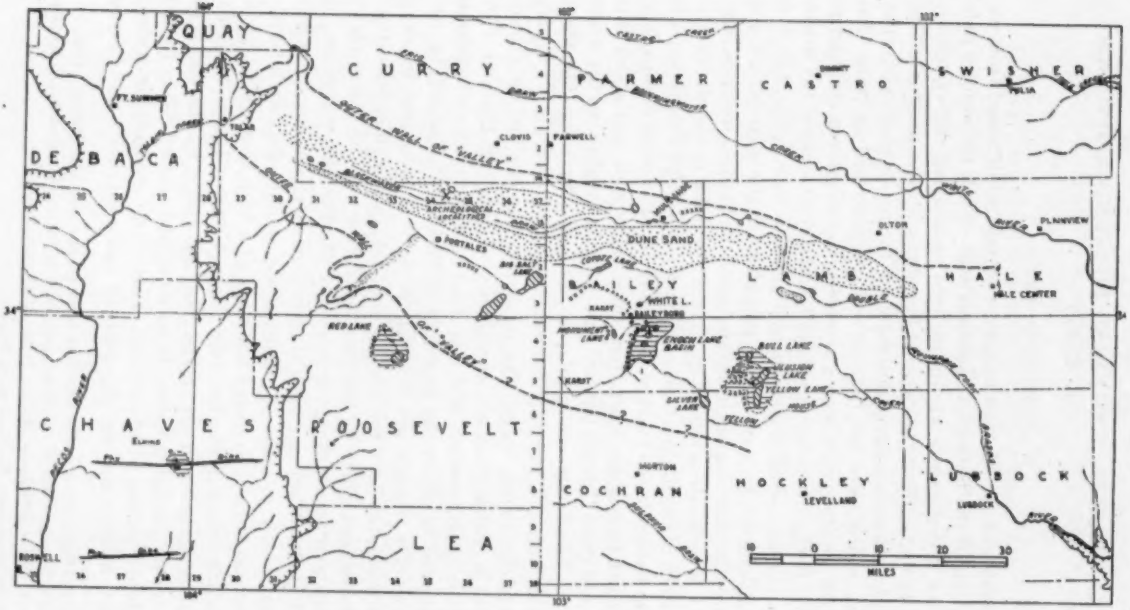

FIG. 33.—Reconnaissance map of Pecos and Portales "valleys," or slump troughs. Cap rock escarpment hachured; local cap rock scarps in slump basins shown by lines of crosses; modern and ancient playa outlines are approximate only; upland cap rock karst not shown; *Phy*=porphyry.

trough, except for the narrow, steep-sided modern stream canyons. These comprise only a small fraction of the width of the trough south of Clovis.

Within the slump basins and slump troughs are scattered basins of lesser size which lie at various depths. Characteristic features of these inner basins, as well as of sections of the larger depressions within which they lie, are sharp scarps topped by outcrops of indurated cap rock (*caliche*). The cap rock outcrops, like the basins, lie at independent levels. The *caliche* may slope toward the basins and usually displays small karst basins of the cap rock section. These various "caps" are believed to lie on slump blocks and slumped areas and to represent a single bed, with an occasional outcrop of the lower calcareous beds of the Ogallala Tertiary section.

Extensive study of the *caliche* and cap rocks of two large arid-region table lands of North America—the Llano Estacado and Reynosa cuesta[4]—and of the data on their geology and soils indicates that their calcareous cap rocks are far too thick to be attributed to soil hardpans or surface crusts formed by evaporation.[5] This applies also to the local silicious variations of the same cap rocks. These caps reach a thickness of thirty-five feet in the Llano Estacado and are over one hundred feet thick in the Reynosa cuesta of South Texas and Mexico. One such bed of the latter table land is known to maintain this thickness for a distance of one hundred miles and a lesser thickness has not been observed in it by the writer. This thickness is maintained also for at least twenty-five miles down the dip of the Tertiary strata under cover of later beds. Moreover, below a surficial zone of "calichification" the Reynosa marl is in some places structureless[6] or stratified. Therefore, these *caliche* cap rocks are now thought to be sedimentary limestones altered in the upper, soil-affected zones. The zone of strong "calichification" has not been found to be more than eight feet thick in fresh cuts.

The "calichification" of the cap rock beds includes the development of a pisolitic or nodular structure. The pisolites are oval to irregularly polygonal in cross section, fine-grained and structureless within, and enclosed by thin lines of dark coloration surrounded by a pasty matrix of fine-grained calcium carbonate with varying amounts of fine-grained silica. The depth of pisolite development in the bed seems to be variable but is probably complete nearly everywhere in the Llano Estacado.

[4] Price, 1933.

[5] Contrary to Price, 1933.

[6] The Reynosa cuesta cap rock is columnar in its northern extent. This is an induced structure of root molds. It has been observed to a depth of 35 feet, to the base of the exposed section.

Study of the published accounts of caliche cap rocks of arid table lands of the world indicates many striking similarities to those of North America described above.

The caliche cap rocks of arid and semi-arid North America show a remarkable development of internal compression folding, with breciation, fracturing, and overthrusting.[7] Slickensides are abundant. This may be seen in the Portales trough in a quarry three miles east of Muleshoe, Bailey County, Texas, just north of Blackwater Draw, and on Yellowhouse Canyon at College Avenue, Lubbock, Texas. These particular occurrences seem to be siliceous limestones of later age formed in basins of the Ogallala cap rock. Internal flow of ashy—that is, fine-grained—siliceous or calcareous material seems to be a common feature of these internally fractured beds, probably in some cases producing the matrix which flowed around the fractured fragments. Seepage of waters charged with slight amounts of iron and manganese coloring matter through the bed, and concretionary growth of calcium carbonate with these minerals around the fractured pieces, with repetitions of ashy flow, concretionary action, and seepage of solutions, seem to provide the mechanisms necessary to produce the pisolites. Refracturing of the rock and repeated concretionary growth developed second cycle pisolites. The manganese mineral wad is abundantly deposited as dendritic films through the cap rock, in places making visible a sedimentary banding. Beds below the cap rock are not affected by the folding which it displays, but lower calcareous beds may themselves have internal folding. This folding is attributed to volume changes of weathering processes under alternating climatic types.

The soft *caliche* of the Clovis localities, discussed by Sellards,[8] has not been reexamined since the foregoing conclusions as to deep-seated slump were reached. It is now thought to be of cap rock or post-cap rock sedimentary origin, but could be pre-cap rock Ogallala in age. The sediments deposited over it and its reported absence on some walls of the pit seem to support Sellards' conclusion of an unconformity.

Induration of the cap rock is a function of the time, period, and topographic position of exposure. The older scarps have indurated cap rock; fresh scarps in the heads of young draws and outcrops beneath protecting lee dunes of former wind systems blowing from the west may be soft and inconspicuous, the cap rock being difficult to find and to recognize in such places.

The conception of a Brazos river flowing through the Portales trough[9] in a wide valley seems to have no secure basis. The development

[7] Price, 1925; Woolnough, 1933.
[8] Sellards, 1940.
[9] Baker, 1915; Bryan, 1938.

of the idea by Bryan was an intriguing concept which led the writer to investigate features of the regional physiography which might otherwise have been missed. No visible valley is to be found east of the Bull Lake vicinity, Hockley County, Texas, and the tongue of dune sand which terminates near Olton, Lamb County. Baker[10] states that he had not followed it east of the Yellowhouse Ranch vicinity (See Yellow Lake, Fig. 33). Water well logs from the eastward projection of the Portales "valley" do not reveal a buried valley fill. A closer search with many borings may be needed before we may positively deny the existence of a wide buried valley on the meridian of Lubbock, Texas, but there are no facts in hand which justify an assumption that such a valley exists.[10a]

In the light of the conclusion that large slump basins and slump troughs exist in the Llano Estacado and to the west, present levels of gravel beds, stream valleys and terraces, lake shores and trough floors in the Portales trough of the Clovis localities are not significant of past geologic history except as they may display the effects of deep-seated solution and local subsidence. The direction of flow of the stream which deposited the coarser strata of the Clovis Beds[11] must be determined by other criteria than present gradients of the deposits. The age of elevated terraces in the valley may not be determined by analogy of position with stream terraces of more stable areas, nor does it seem likely that they can be traced and correlated with terraces of other regions by physical continuity. It is not established what surfaces are erosional terraces and what are collapse terraces.

The study of the Clovis localities is inviting to the geologist but must be approached with extreme caution. Frank Bryan's study injected features of interest, but led to false conclusions. The dune sand which he took to be a marker of an ancient stream deposit fits into the regional mapping of ancient dune-forming wind systems[12] and of vanished dune fields studied by the writer. The tongue of dune sand of the Portales trough—Bryan's "sand crawl"—is evidently a relic of the former great dune field which crossed the plateau along the meridian of Clovis. The Portales sand was preserved because it dropped below the level of the plateau and was thereby protected from later winds. Its new position near water-level in the trough may have assisted in preserving the sand by promoting the growth of soil-retaining plants.

The Clovis gravel probably belongs to the pre-cap rock Ogallala and therefore does not bear on the age of the overlying beds containing

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[10] *Op. cit.*, p. 53.

[10a] Later work shows the trough has a shallow extension, 40 miles wide, to Lubbock and possibly further east.

[11] Sellards, 1940, pp. 395–399. [12] Melton, 1940.

the artifacts and fossils. The ancestral Brazos drainage developing in the early Portales trough must have been much disturbed by the areally irregular subsidence. This was further affected by local solution in the depressed cap rock. The Clovis beds formed in basins possibly of double origin—local solution and regional slump. The detailed physiographic history of these stream courses and lake basins is probably too complex to be read. The internal evidence of the plant and animal remains may, after all, prove to be the best criteria of age in this complex area.

The hypothesis of slump or collapse basins and troughs was long ago stated by Johnson[13] and has lately been developed for the Pecos and Portales troughs by United States Geological Survey geologists working with Charles V. Theis with headquarters at Albuquerque, New Mexico.[14] The writer has tested the hypothesis with regard to the physiography of the Llano Estacado and finds that it fits not only the facts which these geologists had at their disposal, but also other pertinent series of facts connected with the underground structure.

Under the hypothesis of slump troughs, all of the age estimates made by Frank Bryan must be greatly revised. In particular, this is true of his estimate of the time required to cut a 28-mile-wide Pecos valley, supposedly against the resistance of a highly indurated cap rock.[15]

Overlooking, as Bryan does, the normal process of undercutting cap rock by side wash of the loose sands which support it, and assuming that the entire trough width west of Clovis had been cut by stream erosion—which the deep-seated slump hypothesis denies—we still have the misconception of a highly indurated cap rock throughout the period of cutting. If the cap rock is a sedimentary bed which has been indurated by calcareous and siliceous cementation only where and when long exposed, as the writer believes, much of its removal may have occurred when it was in the stage of soft, sandy marl, especially when the cutting was rapid. Hence, its rate of erosion probably was—as Bryan intimates it would have to be to give the short time of prior estimates of the age of the Clovis finds—at least ten times as fast as the present rate of surface weathering of indurated scraps.

Conversation with Frank Bryan disclosed that he based his idea of 1,774,080[16] years for the age of the Clovis finds on a misconception of the nature of the cap rock of the High Plains. Because it is locally composed of recemented fragments of silica resembling chert nodules, he assumed

[13] Johnson, 1901, 1902.

[14] Morgan, Frye, and Schoff discussed the hypothesis at the Dallas meeting of the American Association for the Advancement of Science, 1941.

[15] Bryan, 1938, p. 128.

[16] Bryan's figure of 2,000,000 years at the bottom of page 128 of his paper (1938) seems to be an error of computation for 200,000.

it to be a residual bed formed by the solution of great thicknesses of underlying Cretaceous limestones.

The writer finds nothing in his view of the history of the Llano Estacado and of the Portales trough to upset the conclusion that the Clovis finds are post-Ogallala, post-cap rock, and possibly of comparatively late Pleistocene or even early Recent age. The deposition of eight or ten feet of pond, eolian, and stream deposits in a sunken basin of this size does not, per se, require many centuries. The degree of induration of the ash-gray bed or "blue sands"[17] under an arid or semi-arid climate is not remarkable, nor is the amount of erosion produced by modern arroyos. The process of deep-seated slump might be expected to go on at an accelerated rate as entrenchment of streams carried their beds nearer to the limestones and saline deposits, with increasingly ready access to them by surface waters.

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Corpus Christi, Texas
August, 1942

[17] Sellards, 1940, Fig. 4.

THE ARCHAEOLOGICAL SURVEY OF THE NATCHEZ TRACE

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THE Natchez Trace Parkway is an area, still in a construction stage, controlled by the National Park Service. The Park Service's three general policies of presentation, protection, and interpretation are familiar to most Americans through either reading or travel, or both. Recently an innovation in Park Service areas—on a grand scale—has been introduced by congressional action, so that the Service has begun the development of a series of parkways. These parkways—sired by the East's super-highways with restricted traffic—are in effect elongated parks consisting of a high-standard roadway insulated from unsightly commercial encroachment and despoliation by the usual Park Service regulations regarding protection of natural beauty. Of the three parkways, the George Washington in Virginia is both scenic and utilitarian, the Blue Ridge is essentially a scenic recreational effort, while the Natchez Trace Parkway is commemorative of an ancient road of considerable importance in the early history of the nation. The function of the Trace, as a parkway, will be to provide a highway, essentially restricted to pleasure use, through the South from Nashville, Tennessee, to Natchez, Mississippi. Dotted along its length are many historic sites associated with the primitive road of the early nineteenth century. Appropriate developments will identify and explain to the historically minded traveler such sites as old stands or taverns, Indian boundary lines, treaty grounds, and related areas. Further interpretative devices, presenting the Indian history of the region, will include in situ archaeological displays at some of the many sites within the right-of-way.[1]

FIG. 34

As the Trace passes diagonally southwest from Nashville to Natchez

[1] See U. S. National Park Service, 1941.

it cuts across several physiographic areas and archaeological provinces. Whereas most archaeological surveys are set up to gather data from a given drainage or from an area determined by natural barriers, the Parkway survey was confined by legislative language to a narrow zone extending a few miles on each side of the proposed roadway. Quite accidentally, the work to be done was in country largely unexplored by students of archaeology. At two points, the Parkway, again by accident, intercepts zones whose cultural picture is well defined. At its Tennessee River crossing of Pickwick Lake, Webb and his associates have discovered and described an oft-observed sequence of cultures.[2] The second area, near Natchez, Mississippi, has been surveyed and its cultures arranged chronologically by Ford.[3]

Obviously, the most important task in organizing the material and determining the problems in this situation was the sampling of areas within the limits of the project where no reported data existed. As a result of work in these "blind spots" several cultural sub-areas were defined for investigation. The southern-most or Adams area showed, naturally, the Tchefuncte, Marksville, Troyville, Middle Mississippi, Coles Creek, Natchez sequence of occupation. A second area—the Madison—was defined in Central Mississippi. Here Baytown (first called Deasonville), Coles Creek, Early and Late Middle Mississippi, and Choctaw remains were found. In the northeastern part of the state, in what is called the Lee area, a series of pre-Chickasaw occupations was demonstrated, in addition to that by the historically known Chickasaw proper. In the Tennessee River region the long sequence described by Webb[4] provided an excellent datum of reference. Then, on northeastward, is the rough Tennessee hill country where only Archaic remains were found, except where the Buffalo and Duck River valleys allowed Middle Mississippi groups to penetrate the hill lands; this area has been called the Wayne area. And in the Nashville area, the valleys of the Harpeth and Little Harpeth yield Archaic and Middle Mississippi remains. Thus we have six major areas, showing a diversity of cultural content and a comparable diversity of cultural origin: these are the Adams, Madison, Lee, Tennessee River, Wayne, and Nashville areas.

After study of the material from these sub-areas, it was apparent that the area most in need of exploration was the Lee area, in northeastern Mississippi. With WPA assistance, a short excavation program, supervised by A. C. Spaulding, was initiated at sites selected to some degree on the basis of the surface collections. The sites were all in the Chickasaw Old Fields just west of Tupelo, Mississippi. This and a small

[2] Webb and DeJarnette, 1942.
[3] Ford, 1936.
[4] Webb and DeJarnette, 1942.

amount of earlier work in the same vicinity produced a fairly adequate framework of Chickasaw material culture, as well as a vague outline of the sequence of pre-Chickasaw occupations.

The features of the Chickasaw culture of the early 1700's, observed at four badly eroded sites, are briefly recapitulated below:

The sites are usually located on top of a ridge, overlooking one of the many major creeks which comprise the western headwaters of the Tombigbee river. The entire Old Fields is generally rolling territory, dissected by the creeks just mentioned. When first reported by Europeans, the Old Fields was called a prairie, so apparently no timber existed in the region. Whether the area was naturally treeless or had been denuded by centuries of Indian use is unknown. The villages extended along the tops of low ridges without particular arrangement or orientation. Adair claims that the main village was some four miles in length. Surface indications are that the houses were rather loosely grouped along the ridges, probably within sight of one another. Two types of house patterns were determined. One, and by far the most common, was a round house. Actually the houses could be called either round or square. Each of four walls was straight for perhaps eight feet; the corners were deeply rounded to connect the four sides and to make a house averaging 22 feet in diameter. The walls were of round posts set vertically in individual postholes. According to Adair, the posts were interwoven with cane or strips of white oak and plastered with mud, but his statement is not substantiated by archaeological finds of burned casts of wattle-work. Another type of house described by Adair was the rectangular summer house. Presumably, its walls were also of wattle and mud daub. Of the houses of the rectangular type which were discovered, only two showed the use of a wall trench in which the vertical posts had been set. In several others, no evidence of posts was found, although a trench had been prepared. There is little evidence available as to the interior furnishings or arrangement of the small Chickasaw dwellings. Occasionally, a house pattern is bisected by a series of vertical post molds. These are interpreted to be the remains of a partition, or of supporting posts. No fireplace of any kind was discovered inside a house. Occasionally, there is a flattish burned zone within the house pattern. The basal part of a pit, 10 inches in diameter, with fire-reddened sides may have represented a fire pit. Its top was plowed away. It was outside any house pattern. It may be that no modeled fireplace was used or it may be that all evidence of fire pits had been destroyed, as had any evidence of prepared floors, through erosion or cultivation.[5]

Burial customs can best be described in conjunction with the house

[5] Adair, 1775, p. 451, implies that fires were built on the floor without any prepared basin or other modeled fireplace.

structure, since nearly all burials were made inside the house. According to Adair, a deceased individual was placed beneath his couch;[6] excavation corroborates his statement. Generally the burial was flexed and lay inside an oval pit just large enough to contain the body. The pits were never deep, but they were dug and furnished with some care. They were prepared for burial by lining with cypress bark or cane; a covering of the same materials was provided after the body had been lowered into the grave. Nearly every individual had with him a few personal possessions or ornaments, but in every case these grave goods were quite scanty. Usually, beads or European objects were the sole grave furniture. As for the artifacts, relatively little need be said. At all the sites excavated, only European importations such as guns, axes, glass beads, knives, copper kettles, one spoon, bells, iron nails, and other common objects of a utilitarian nature were reported from graves; two tubular shell beads, some shell buttons, and a pipe of native manufacture are the sole exceptions. Presumably because European tools were plentiful, there was a scarcity of aboriginal stone tools or utensils, aside from a few dozen gun flints of native manufacture and some projectile points. Points of the small stemless type were more numerous than the heavier stemmed types in the proportion of approximately two to one. The total number of chipped flint specimens from four sites, moreover, is less than 200.

Near each house was located a borrow pit from which the mud plaster was probably secured. These were usually eight or nine feet across and up to two feet in depth; each contained midden debris. From these midden accumulations good pottery samples were collected. The native Chickasaw pottery can be characterized as decadent Middle Mississippi, both in form and decoration. The paste is characteristically tempered with fossil oyster shell which outcrops all over the Old Fields. A very characteristic pottery type, presumably not Chickasaw in origin, though it was present in significant quantities on site MLe14, is the type known as Fatherland Incised.[7] Subsequent to the excavation of the Chickasaw sites, typical Fatherland Incised sherds have been found on several scattered sites as far south as Mathiston, Mississippi. It is not unlikely that the distribution will be found to extend all the way from the Natchez area, where the type was first discovered, to the Lee area.

From four other sites near the Old Fields, chief of which was the Miller site, and by cross reference to the work on the Tennessee River and in central Mississippi, a succession of earlier cultures was built up. The three cultural periods thus delineated have been named from the type, or Miller, site. These Miller cultures appear to extend from the earliest ceramic periods on up to historic times. Miller I, about which the least is known, is characterized by fiber-tempered plain pottery, found

[6] Adair, 1775, p. 451. [7] Figured by Quimby, 1942, Pl. 14.

in conjunction with sand-tempered, textile-marked sherds. Nothing is known of the dwelling type for this period. The one observed burial, which was flexed, face downward, in a small pit, had been protected or covered by a layer of large sherds.

The remaining two manifestations of the pre-Chickasaw group of remains, Miller II and Miller III, were both found at the Miller site, which consisted of two, almost twin, conical, or domed mounds, approximately 13 feet high by 80 feet in diameter, built upon and sealing an old village site. For several hundred feet in all directions from the mounds extensive village debris was found on the surface. The entire site was near the edge of a low bluff overlooking Yonaba Creek. Back of the site were extensive woodlands, although the site itself was in cultivation. Houses of the Miller II period tended to be elliptical rather than subrectangular, as the Chickasaw houses were, with walls of vertical posts set in single postholes. Fire pits were shallow, irregular basins near the centers of the dwellings. Artifacts were all of native manufacture. Chipped flint objects were preponderantly heavy, rough-chipped projectile points, almost altogether of stemmed form. One celt-type ax, a limestone platform pipe, two copper ear spools of cymbal type, and a shell dipper complete the list of artifacts recovered. Pottery during the Miller II period was heavily sand-tempered and was decorated only with cord marking. A small, conoidal, or pointed-bottom form appeared to predominate. In addition to this cord-marked ware, there was a certain percentage of wares already described for the Alexander site in northern Alabama and the Tchefuncte site in Louisiana.

The burials during this period were either placed in pits beneath the mound, or were scattered at various levels throughout the mound, where they had been laid during its construction. Pottery vessels were found with two of the sub-mound burials. One specimen was of the Alexander Pinched type; the other was Furrs Cordmarked, a local type characteristic of the Miller II level. Most burials were extended. In one case, a burial of two individuals was made between two layers of contrasting clay so that it was set off from the earth of the mound proper. The platform pipe and the conch dipper were with these two burials.

Miller III is difficult to distinguish, in all phases, from the Miller II period. It seems probable that the typical Miller III burial was flexed; in one case such a burial was found inside a sub-rectangular dwelling. The pottery of period III is still cord-marked, but the characteristics of the paste of this period differ markedly from those of the preceding period in that the preponderant aplastic is burned clay rather than sand. There is a remote possibility that at the beginning of Miller III one can observe some typical Chickasaw characteristics. It is difficult to deter-

mine which, if any, of the mound burials are referable to Miller III. The best interpretation at this moment is that the old village and both of the mounds are referable to the Miller II period, leaving only the new village, with its distinctive pottery and house type, allocated to Miller III. It should be clear from the foregoing that the Miller material is not easily segregated into periods in its own light. This has been done chiefly on the basis of the listed cross finds of pottery.[8]

It is believed that the segregation of traits will prove valid. The value of a stratigraphic column built up as a result of the Lee County excavations is to some degree intrinsic, but it will also contribute to the general problems of the Southeast in several ways. First of all, the occurrence of the Alexander or Tchefuncte material within an otherwise exclusively cord-marked complex tends, it seems, to cast doubt on the antiquity now postulated for the former two pottery complexes. It may even contribute toward the chronological placement of the Copena horizon, since Miller II obviously has many affinities with Copena, as recently described by Webb.[9]

It also provides positive stratigraphic differences in the cord-marked pottery of the area. The specimens from the new village at Miller are very closely akin to the Deasonville cord-marked material described by Ford and Collins,[10] whereas the Miller II cord-marked material from the old village is further developed and may resemble more closely the Pickwick Basin finds. It is difficult to determine whether the material from Lee County should be regarded as of an age identical with that of the horizons in distant areas in which its closest connections appear, or whether there existed, in the hilly section of northeast Mississippi, a cultural eddy where early forms persisted into late prehistoric times. In any event, the chronology postulated here is as valid as the work with which comparisons have been made. Only additional work will clarify the contents and relationships of the three Miller periods.

On the basis of the work in Lee county and the cross finds of pottery, it has been possible to build up the chronological column in Table 1, which is intended to show the relationship of the entire Parkway zone to cultural arrangements in related areas.

Generally speaking, the archaeologically determined cultures listed opposite each other in Table 1 and shown as chronological equivalents are to a large extent regarded as cultural equivalents as well. Differences

[8] For a full discussion of the Lee County, Mississippi, finds see Jennings, 1941.

[9] Webb and DeJarnette, 1942.

[10] Recently the term "Deasonville" has been replaced by "Baytown"; the latter term is used to describe a manifestation whose cultural limits are more clearly defined. See Haag, 1940.

result from location and divergent development, of course, but basically (perhaps "phasically" is better) the coeval cultures are variants of the same thing. For example, Miller II is very similar to the Copena of Alabama; again, the three historic tribes were generally evidencing the same cultural habits. In the south, Coles Creek and Late Middle Mississippi materials are found together on many sites and appear to be much the same thing culturally.

TABLE 1

	Natchez	*Jackson*	*Tupelo*	*Tennessee River*	*Nashville*
1800					
1700	Natchez	Choctaw	Natchez		
			Chickasaw		Cherokee
1600	Coles Creek—Late Middle Miss.				Late Middle Mississippi
1500	Troyville—Early Middle Miss.—Miller III—Early Middle Mississippi				
1400		Late Baytown			Late Baytown
1300	Marksville—Early Baytown—Miller II—Copena				
1200	Tchefuncte		Miller I—Alexander		
1100					
				Archaic	Archaic
1000					

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THE PHYSICAL PROPERTIES OF STONE TOOL MATERIALS[1]

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THE diversity of types of stone tools, as of any other class of artifacts, may be regarded as due to differences in the nature and functional relations of the relevant variables existing in the given situations in which these artifacts were produced. These relevant variables may be conceived as of three major kinds: those associated primarily with the individuality of the given artisan, those arising primarily from the cultural matrix in which the artisan lived and worked, and those directly or indirectly due to the resources and nature of the physical environment in which the artisan and his culture existed. In setting up such categories, a corresponding functional dissociation must not be assumed. Each recognizable element in each category is of course functionally related to every other. But the archaeologist must, in attempting to evaluate his material, schematize in some such fashion. He must evaluate, as well as he can, each of the variables involved.

To account for differences between artifacts known to have been manufactured at an essentially identical time and place it is necessary to consider those variables introduced by individual artisans. Such factors as individual skill, momentary impulse or inspiration, accident, chance, and the like, are all potential. However, variation at the level of the individual is implicitly excluded from the considerations of the archaeologist, whose attention must be centered upon similarities and differences of a larger order. Most pertinent, in terms of his interests, are those variables conditioned by environment and culture. In attempting to assess the functional value of each of these latter variables for the production of a given set of artifacts, the set of factors operative at the level of the individual cannot, in the nature of the evidence, be evaluated. But it should be remembered that the artifact is, after all, an individual product.

Those variables inherent in culture may be regarded as of primary importance in determining the mode of working, the utilitarian nature

[1] This study was undertaken at the suggestion of Dr. Hallam Movius, then of the Peabody Museum, Cambridge, Mass. The work was motivated and guided throughout by Dr. Movius, and it was the hope of the writer that he would participate in the authorship of this report. However, Dr. Movius' enlistment and departure from the country in the armed forces made the fulfillment of that plan impossible. This report was completed too late to receive the benefit of his criticisms and suggestions, and the writer is therefore alone responsible for errors or omissions. She wishes, however, to express her indebtedness to Dr. Movius for his large part in the organization and general conceptual scheme of the study.

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and non-utilitarian embellishment, of a given artifact. But there has perhaps been a tendency, as has been pointed out,[2] to consider artifacts themselves as equivalent to culture. To do so is to fail to consider the total situation in which they were produced, and the nature of the functional relation between environmental and cultural factors. The archaeologist should qualify his conclusions to the extent that he cannot determine the nature of *all* of the variables with which he is dealing.

Among environmental factors which may greatly affect the kinds of artifacts produced, the nature of the materials available to the artisan is of primary importance. Within the limits set by availability, the choice of certain materials may be purely a matter of tradition and may even be inconsistent with purely utilitarian considerations. On the other hand, the resources of the environment may be fully explored and materials chosen upon the basis of cultural standards of utility. Whatever may have been the functional relation between environmental and cultural factors in a given case, we need to know as much as possible about each set. A study of technology is not complete without some knowledge of the properties of the materials utilized, and also, if possible, an inventory and similar knowledge of those which were not utilized.

Such knowledge is of especial importance to the student of cultures whose remains are limited, or nearly limited, to stone implements. To reconstruct history from bits of rock surely requires the most exhaustive exploitation of every possible avenue of interpretation, the fullest possible knowledge of all of the relevant variables. It is possible that certain assumptions of cultural affinity, based upon types of stone tools, might be somewhat shaken were all of the evidence in. Conversely, certain apparent divergences might prove to be more of degree than of kind. Thus an investigation of the physical properties of materials used for stone tools must be regarded as a significant sector within the area of archaeological focus, and as a contribution to a body of data through which the nature of an important variable may be defined.

The physical properties of such rocks as flint, obsidian, quartzite, etc., are but briefly discussed in geological literature. The relatively limited attention granted such materials is primarily devoted to consideration of their origin, structure, and distribution. Such information is certainly of general interest to the archaeologist and should be made available to him in some *one* synthesis of the many scattered and often obscure sources. However, the major interest of the archaeologist naturally lies in such characteristics of the rocks as may be expected to affect the ways in which they can be shaped into tools, and the peculiar utility and durability of such tools. This range of characteristics is included in

[2] Rouse, 1939.

the term "physical properties" as used here. It is a range best definable by performing upon the materials different sorts of operations, under certain specified conditions.

Hardness, for example, is a diagnostic physical property of minerals. It is nearly always reported in mineralogical literature in terms of the Moh scale. The operational procedure by which hardness is thus commonly defined is the scratching of the unknown material with a material of known hardness. The Moh scale provides for only gross differentiation, with talc at the lower end and diamond at the upper end of a scale of ten. On the basis of this useful but crude measure of hardness most stone tool materials have a value of seven, though a few are said to give values one or two units lower. Several other methods of determining hardness have been devised and used more or less widely, but one of three general principles of operational procedure appears to underlie all hardness tests. These are (1) resistance of the material to scratching, (2) resistance to abrasive wear, and (3) resistance to penetration.

Measurements of hardness, or of any other physical property of materials, can be made only in terms of such general types of operations, and the numerical values thus arrived at must be qualified in two important ways: (1) they cannot be regarded as of any absolute value, but as of relative significance only, and (2) the property measured may not be regarded as an isolable quality of the material, but simply as a measure of the behavior of the material under specified conditions, this behavior being a result of the whole nature of the material. That is, the statement that flint has a hardness of seven must be qualified by an indication of the scale of relative values from which this value derives its significance; i.e., the Moh scale. Having indicated so much, it will be understood by everyone familiar with the operational basis of this scale that a particular type of hardness is referred to, i.e., hardness associated with the resistance of the material to scratching. The point is, and it must be borne in mind in considering the measurements made in the course of this investigation, that *such terms as hardness, toughness, and resiliency are but blanket labels generally understood to cover a complex of characteristics that can be made manifest only by doing something to the material.* There are other terms, such as tenacity, cohesiveness, brittleness, etc., which are of the same general nature. Presumably no single operation could measure any *one* of these, even if it could be defined other than through a specific operation, since the behavior of the material is probably always due to interacting factors of the structure and composition of the rock. The forcing of a diamond point into a material under a specified load is assumed to be a measure of something called "hardness," yet the properties implicit in the popular usage of the terms

"toughness" and "brittleness" are probably also involved. Thus the name of the property said to be measured by a given operation must be regarded as essentially arbitrary, while the significant matters are (1) the *nature* of the operation performed, and (2) the *relative* value of the measurements obtained. In reporting the tests carried out in connection with this investigation, these aspects will be stressed.

The choice of tests was limited, first of all, by the nature of the testing apparatus accessible, since neither time, financial resources, nor the skill and experience of the investigator permitted the design and construction of special testing devices. Within these limits, choices were made upon the basis of such practical considerations as the quantity of sample required, the possibility of making more than one test upon a given sample, and the simplicity of the procedure. Primary emphasis was placed, however, upon choosing tests of such operational nature as promised to be most directly indicative of the workability and durability of materials used for stone tools, and of such precision as to be indicative of differences of a low order of magnitude. For example, scratch hardness is a very simple test, ideal from the standpoint of purely practical considerations, but it measures the behavior of the material under conditions unlike those prevailing when a tool is shaped and used. Furthermore it is incapable of registering other than gross differences between materials, as has been pointed out.

The necessity for measuring small but potentially significant differences between widely used materials arises from the general nature of these materials. A given type of rock, to have been long or widely used, must have satisfied certain general requirements. It must have been rather easy to chip and relatively hard, tough, and fine-grained (to use these terms in a rough and general sense). Trial and error selection has established the limits within which rocks are suitable for the making of tools. The *degree* to which the *nature of the material* may have determined the type of tool produced can thus be evaluated only in terms of rather precise measurements of properties within this narrow range.

It was on the basis of these considerations of practicality and precision that the testing carried out in the course of this investigation was decided upon. The operational procedures chosen seemed, in the beginning, to satisfy the necessary conditions. Subsequent experience, however, did not wholly confirm the original assumptions. This was particularly true in regard to the first of the series of measurements made upon each sample—the measurement of density.

Density was measured by a gravimetric method. Information concerning the density of the materials was regarded as important because this characteristic is an excellent key to their general nature. Glassy

materials, for example, are characterized by densities of approximately 2.20 to 2.30, while flints and cherts ordinarily range between 2.50 and 2.65. It is probable that density values, if carefully measured, would be significant to the second decimal place. This fact, unfortunately, was not fully realized until it was too late to adopt a more precise method.

The second property measured was hardness. The penetration method was used for two reasons: first, because two excellent standard testing devices working on this principle were made available to the investigator; and second, because measurements so made might be expected to be relevant to the behavior of the material under pressure, as in pressure flaking, and to its general tenacity when in use as a tool.

Measurements of toughness were also made, the operational procedure in this case being to place the sample in a standard testing device in which a hammer fell upon it from increasing heights. The height of fall required to fracture it is the measure of its toughness. The relevance of this measure to the workability and durability properties of tool materials is fairly evident.

Resiliency, as measured by the height of rebound of a hammer from the surface of the sample, might be expected to shed some light on the workability of a material, and also to indicate something concerning its wearing qualities. This test was a crude approximation, though probably quite adequate for these purposes, of the elaborate measurements of the elastic constants of rocks which have been made by Dr. Francis Birch, of the Division of Geological Sciences at Harvard University.[3]

Measurements were made upon obsidian, silicified volcanic tuff, fossil wood, flint, chert, quartzite and limestone. Obsidian, flint, chert, and quartzite were chosen because they have been perhaps more extensively utilized for tools than any other materials. Silicified tuff and fossil wood, though much less widely used, were of particular interest to the investigator.[4] Limestone was included for comparative purposes only, since most limestones are too soft to make satisfactory tools, and also because they lack the conchoidal fracture that makes for ease in chipping. The tests performed were thus expected to show a wide discrepancy between limestone and all of the other materials, as they indeed did, thus providing a simple check on the gross accuracy of the measurements.

[3] While the scope and aim of Dr. Birch's work were wholly different from those of this investigation, his familiarity with the problem of measurements of properties of rocks made his comments and advice most helpful. Dr. Birch also supplied a sample of obsidian and another of quartzite. These were materials which he had tested. The results for the Modoc County, California, obsidian are reported in Birch and Bancroft, 1938.

[4] The samples came from Dr. Movius' Burma collection, in which these materials were heavily represented.

Major emphasis was placed upon flint, with twenty-five of the total of thirty-five samples being of this material. Since the scope of this investigation prohibited the examination of more than this number, it seemed advisable to study one material relatively intensively, in order to determine the variability of a number of samples cut from the same nodule, and of samples cut from different nodules taken from the same site. Since East Anglian flint appears to be a highly homogeneous material, the amount of variability of samples from the same nodule might be expected to be more indicative of measuring error than of true difference. Samples were taken from three fresh flint nodules, hereafter referred to as flints I, II, and III. In each nodule samples were cut in three mutually perpendicular planes, in an effort to check the frequent contention that flint has "grain" and that it thus flakes preferentially in a given plane.[5] It can only be said here that the variability of all the samples—that of samples cut on different planes, and that of samples cut from different nodules—appears to be of approximately the same order of magnitude, and that it is, as will be seen, surprisingly large. All of the flint was macroscopically dense and fine-grained and was medium to dark gray with faint spots or blotches of lighter gray or white. There were no apparent breaks in its homogeneity save for this difference in coloration.

The material here referred to as "chert" is so called principally to distinguish it from the East Anglian flint, from which it differs conspicuously in macroscopic characteristics. The source of this material was a formation known as Flint Ridge, in Licking County, Ohio.[6] Since there exists no commonly accepted set of standards by which flint and chert are defined and distinguished, and since terminology is entirely a matter of tradition and personal preference, no compunction was felt about arbitrarily renaming this material.[7] The general color of the rock is a light, creamy brown. Through this background run barely perceptible to strongly marked meandering black lines. These lines are possibly due to metamorphism. Their appearance suggests incipient fractures, yet there is no evidence that the rock is particularly weak at these places. Two contiguous samples were cut and tested.

[5] Dr. Movius, in conversation with the Brandon flint knappers, found that they operated upon this premise and had apparently good reasons for their opinion.

[6] This material was obtained through the courtesy of Mr. H. Holmes Ellis, of the Lithic Laboratory of the Department of Archaeology of the Ohio State Museum.

[7] Ellis, 1940, has neatly summarized the deplorable state of confusion existing in mineralogical and archaeological literature in regard to terminology for flint and similar materials. He suggests that all materials of this general nature be called "flint." It is the opinion of this writer that terminology for tool materials should be completely revised along taxonomic lines, the divisions being based upon the complete roster of characteristics of each rock. This would be difficult without more thorough knowledge of each.

Quartzite is represented in this series by but two samples cut close together from a single piece of fine, white Georgia quartzite. Of the three obsidian samples, two were from a large, fresh, Modoc County, California, specimen, and one was from a somewhat weathered nodule whose source was Obsidian Cliff in Yellowstone Park, Wyoming. All were black and translucent, and the Modoc samples were highly homogeneous in general appearance. The Yellowstone sample was unlike the others in showing an uneven distribution of small, spherical, whitish areas. The tuff and fossil wood samples, one of each, were cut from slightly worked pieces from the Irrawaddy terraces of Burma. Both were quite weathered. The tuff was rather porous at one surface, becoming increasingly dense and siliceous in the direction of the opposite face. The finished sample was from the most siliceous part of the specimen. The wood was highly siliceous. The finished sample carried a small incipient fracture, but was otherwise fresh and homogeneous.

It was possible to make all of the measurements previously discussed upon a given sample by testing toughness last, since this was the only test that resulted in serious deformation of the sample. It was of course necessary to prepare samples of standard size, shape, and condition. The Paige Impact Tester, designed by its makers as a test of "toughness," requires that samples be cylinders of approximately one inch in both diameter and length, with both ends perpendicular to the axis of the sample. All other tests could be made upon samples of these specifications, with the additional requirement that the end surfaces be polished to remove visible scratch marks. Cutting samples, of whatever shape and dimensions, from rocks of a Moh hardness of 7 presents a serious problem. They can be cut efficiently only with diamond, but diamond drills are expensive and require frequent replacement when used upon flint and similar materials. It was found that cylinders could be cut, slowly but inexpensively, with a drill made of copper pipe, using silicon carbide (carborundum) suspended in water as the abrasive. The cutting rate varied from about one-quarter to one-half inch per hour, and the drills wore away at about half that rate. The drill was rotated in an electric drill press. The rock to be cut was set in a box in which it was held firmly in a matrix of plaster of Paris. Also set in the plaster was a funnel, the small end of which was a little larger than the drill. Through this opening the drill moved down into the rock. The funnel served to channel the abrasive and water to the cutting edge of the drill. In order that the drilling should not require constant attention, an automatic shut-off mechanism was devised to stop the motor in case the drill jammed.[8]

[8] For the loan of the drill press the writer is indebted to the Geology Department of the Massachusetts Institute of Technology.

The design and construction of the drills, automatic shut-off, and other essential

The cylinders of rock thus cut from the original nodule had next to be sawed into lengths of approximately one inch. A diamond saw, consisting of a copper disc set peripherally with diamond chips and rotated at high speed, was used for this operation. The saw left the ends of the samples ridged and frequently not perpendicular to the axis of the sample. To correct these defects both ends were polished on "laps" (heavy, power-rotated discs). This operation was facilitated by setting several samples in plaster of Paris within the confines of a metal ring. They were in this fashion held upright and perpendicular to the surface of the lap. As in the preparation of mineralogical specimens, the samples were first polished upon an iron lap, with carborundum and water applied from time to time. After the ridges left by the saw had been thus removed, the process was continued on a copper lap with finer carborundum until the scratches left by the preceding operation had been removed. For general testing purposes the sample was at that point adequately polished. But on twenty-eight samples one face was brought to a mirror finish by continuing the process with successively finer abrasives on a series of glass plates and cloth-covered wheels.[9]

The samples subjected to high polishing were so prepared that they might be photographed under magnification by reflected light. This is a technique utilized in metallurgy for the comparative study of surface structure, and has not been previously applied, so far as is known, to the study of rocks and minerals. Its use in this investigation was in the nature of an experiment. It promised a simple and inexpensive alternative to thin-section studies of structure. Furthermore, it seemed desirable to preserve a photographic record of a section of the surfaces of the samples that were to be tested. It was found, however, that photographs made in this way showed little but the macro-structure of the rock and the effects of the polishing process upon its surface. The component grains of the quartzite were plainly shown, as were the meandering dark lines in the chert and the blotchy areas in the flint, but these are superficial characters nearly as easily observable in the original specimen. From this standpoint, the photographs may be regarded as of particular value only as a record of the appearance, under fifteen-diameters magnification, of a section of the surface later tested. The pictures also

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pieces of apparatus were the work of Professor Clark Goodman and Dr. J. W. Irvine of the Massachusetts Institute of Technology. Without their generous assistance in this and many other ways, this investigation could not have been carried out.

The writer is also indebted to the Physics Department of the Massachusetts Institute of Technology for the use of laboratory space and general facilities.

[9] The diamond saw, the polishing laps, and the general facilities of the mineralogical preparation room were very kindly made available by Professor W. J. Mead, Head of the Geology Department of the Massachusetts Institute of Technology.

give some clue to the reaction of the materials to abrasion, which has been mentioned as one of the ways in which hardness can be measured. They show that numerous small pits were left in the surfaces of all of the samples by the carborundum used in polishing. In obsidian these pits are definitely larger and more numerous than in any of the other materials. This suggests low abrasion hardness for obsidian, a property doubtless related to its glassy and "brittle" character. Eleven samples were photographed by this method.[10]

Once finished and photographed, the samples were ready for the series of measurements. In the appended tables will be found a summary of these measurements. For each material there is given the range of values and the arithmetical mean of the values of a given type of measurement. Since it was possible to repeat the hardness and resiliency measurements on a given sample and to make them on both faces of the sample, the means for these properties are drawn from an average of five or more (twenty-one for resiliency) readings per sample.

The values first determined were those for density. The gravimetric method used consisted in weighing the sample, determining its volume by noting the volume of water it displaced, and dividing mass in grams by volume in cubic centimeters. As was previously noted, this method is probably not productive of values good to the second decimal place. Hence it is felt that the density table should be regarded as indicative in a general way only. The order of increasing density is probably substantially correct.

Hardness tests were next made by utilizing two different commercial testing devices which are in common use for the testing of metals and building materials. Both are recommended by their manufacturers for use upon rocks, but no reports of such measurements could be found in the literature. Both operate upon the principle of penetration. Hardness values thus determined for metals and for such materials as concrete may not be assumed to be more than very roughly comparable to those obtained for rocks, owing to the inherent structural differences between these types of materials. But it is interesting that most of the values obtained for the rocks, limestone excepted, were within the extreme upper range of the scale for metals.

The Rockwell Superficial Hardness Tester provides a measure in terms of the *depth of penetration* of a sphero-conical diamond point *under a given load*. A load of fifteen kilograms was chosen, and all penetration depths were read under this load. The arbitrary instrument

[10] Professor Carl F. Floe, of the Department of Metallurgy of the Massachusetts Institute of Technology, very kindly allowed the use of the necessary apparatus. The writer is also deeply indebted to Professor Floe for the use of the Rockwell and Shore hardness testing devices, and for his assistance in the operation of these instruments.

scale which is used reads inversely, i.e. a low penetration corresponds to a high hardness value. Reference to the table will show that limestone, as was expected, fell far below the next lowest Rockwell hardness, being separated from silicified tuff by about 54 points. It will be apparent that this is a very great differential when it is realized that the means for the remainder of the materials fall within a range of 7.8 points. It is noteworthy that, while the *lower* limits of the range vary, within this latter group, by 36.5 points, the *upper* limits are nearly identical. The fact that obsidian shows a lower limit of 58 and a mean of 89.1 is perhaps indicative of the unsuitability of this test to so brittle a material, and to a lesser degree this may be true of the use of the penetration hardness test for all rocks. The validity of the reading is dependent upon the firm seating of the diamond point. If the material shatters minutely at the point of pressure, the reading will be lower than the true value. The high values may thus be more accurate than the lows, which are so erratic. If this is the case, the means are of course low. Whenever the material cracked audibly under the application of the load, the reading was discarded. This result was more frequent for obsidian than for any other material. Since the upper limit for the obsidian range is as high as that for most of the materials and its mean is but 6.3 points lower than the highest mean, we may conclude that, though obsidian shatters easily under pressure, it is probably nearly as hard as flint, chert, etc. This substantiates the observations of tool-makers, who generally prefer to work upon obsidian or glass because of their ease of flaking and retouch. Obsidian tools are not, however, noted for durability.

It is of interest that the means for the three flint nodules cluster, with a 0.6 point range. Only quartzite and chert (difference 0.2) appear to be less differentiated than are these flints from one another. All three flints gave means higher than those for any of the other materials.

The Shore Monotron measures hardness in terms of the *load in kilograms* required to produce *a given depth of penetration*. The constant here is penetration, while in the Rockwell tests it is load. Readings were taken at penetrations of 5/5000 and 10/5000 inch, after preliminary testing had shown that all materials could support the load required to produce the lesser of these depths. Interesting differences in the behavior of the materials appeared under the load conditions required to produce the 10/5000 inch penetration.

A glance at the tabular summary of the Monotron hardness measurements will reveal their general correlation with the Rockwell hardness values. Looking first at the means for the 5/5000 inch penetration, it will be seen that limestone is again outstandingly low; that obsidian and tuff are second and third lowest respectively (as in the Rockwell series, but with their order reversed); that the three flints are again

highest in hardness (with the order of I and II reversed); and that chert, fossil wood, and quartzite are again midway between the obsidian-tuff and flint groups (with the relative positions of fossil wood and quartzite interchanged).[11] It can thus be said that the means for the two series of hardness measurements are in general agreement. The specific differences may be due to the inadequate number of samples. The range of the 5/5000 inch Monotron measurements also shows the same general characteristics as does the Rockwell range, with obsidian again reaching a significant low. The upper limits of the ranges are, however, much more variable than in the Rockwell series.

Turning to the values for 10/5000 inch penetration, several interesting features appear. The blank spaces in the record indicate that no valid readings could be obtained. This was due, in the case of limestone, to the fact that the material crumbled, i.e. was too soft to support the necessary load. With obsidian and quartzite the defection was due to shattering under the load. From this behavior, ease of pressure flaking may perhaps be inferred for both materials. For those materials capable of supporting the load, the range is again great, with one really extreme high registered for flint II. This high measurement was made, as were other relatively high flint measurements, with the diamond point of the instrument set on one of the small light spots or blotches previously mentioned as characteristic of the East Anglian flint. So far as is known, no explanation of this peculiarity can be advanced on the basis of the structure of the material. The variable coloration of flint is generally believed to be the result of an uneven distribution of iron compounds. These represent but a very small percentage of the constituents of the rock and should have little or nothing to do with its hardness.

Resiliency was measured by the Shore Scleroscope,[12] a standard testing device in which a diamond-tipped hammer falls from a constant height upon the smooth, horizontal surface of the sample. The height of rebound of the hammer, automatically recorded upon the instrument dial, gives the reading.

Resiliency, as was previously noted, is allied to a property or group

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[11] The U. S. Bureau of Public Roads (Goldbeck and Jackson, 1912) reported chert and quartzite as of approximately the same mean hardness, on the basis of abrasion and resistance-to-wear tests. While the looseness of terminology in regard to chert and the failure of their report to describe the material forbid exact comparison, our results for penetration hardness appear to agree with theirs.

This publication represents, so far as is known, the only large-scale testing of the physical properties of rocks ever reported.

[12] The author is deeply indebted to Dr. William Murray, of the Department of Mechanical Engineering of the Massachusetts Institute of Technology, for permission to use this device and the Paige Impact Tester, and for his very kind assistance in making the measurements.

of properties called "elasticity." Either may be expected to be important in the behavior of the material under both percussion and pressure flaking, and in the behavior of tools in use. This may be especially true for knives, scrapers, blades, and other pressure implements.

A glance at the ranges for these readings will show that, excluding limestone, the lower limits exhibit greater variability than the upper, and that the total ranges are very great. It has been seen that the range has tended to be large in the other measurements as well, and a review of the work of the Bureau of Public Roads[12] reveals that their measurements were similarly widely spread. They offered no explanation of this peculiarity, nor is it possible to do so here. Theoretically, the behavior of the scleroscope should be as reliable for rocks as for metals or other materials. It is necessary only that the hammer fall upon a smooth, horizontal surface. These conditions were fully met, yet the range of the values is apparently much greater than would be the case for metals or building materials. In the face of this fact, some skepticism concerning the suitability of the test is justified. On the other hand, it may be postulated that the minute structural heterogeneity of even these dense and fine-grained rocks accounts for their anomalous behavior.

The mean values for resiliency show limestone to be again very low; silicified tuff, the second lowest, is more widely separated from the third lowest material (fossil wood) than is any of the other materials from its neighbors. Indeed, the means for fossil wood, quartzite, chert, and the flints fall within a 7.4 point range, while the gap between tuff and fossil wood, the next most resilient material, is 9.2 points. The difference between the means of flint III and obsidian is but 5.1 points. The materials increase in resiliency in generally the same order as they increase in hardness, with the outstanding exception of obsidian. Hence, with this exception, it may perhaps be inferred that there is a correlation between resiliency and hardness. The relative height of the obsidian mean, plus the relative narrowness of the range for this material, might be taken to indicate relative homogeneity and elasticity. These properties might help to explain the wide use of obsidian in knives, blades, and points. The ease with which the material may be flaked by pressure would also be important in the making of these implements.

As measured by the Paige Impact Tester, toughness is that property or complex of properties which determines under what conditions the material will fracture. The reading is the height in centimeters from which the fall of a steel hammer results in the fracture of the sample. The hammer is first allowed to fall from a height of one centimeter;

[12] Goldbeck and Jackson, 1912.

each successive fall is from a height one centimeter greater than the preceding, until fracture occurs. To reduce the readings for the several materials to a linear scale, it is necessary to take the square root of each, since velocity increases as the square of the height of fall. Hence, in the tabular summary it will be seen that there is given, first, the range in terms of readings directly from the instrument, and, second, the range in terms of the square root of each measurement. From the range of root values the root mean has been calculated. It is these means which give a true indication of the relative toughnesses of the materials, but they have been squared, and presented in the Paige Mean column, to restore them to the terms of the direct instrument readings. This latter operation gives values which may be compared with those reported by the Bureau of Public Roads,[14] where the Paige tester was extensively used.

Examination of the table will show that the linear ranges of the materials adjacent in the scale of increasing toughness consistently overlap, and that those for chert and flint III are identical. In respect to linear mean, these latter materials are again identical. In this set of measurements we once more meet the phenomenon of high variability, as did the Bureau of Public Roads in their toughness tests. In their reports, quartzite showed the greatest range, 5 to 54 for twenty samples, and siliceous limestone the smallest, 5 to 26 for twenty-six samples. These extremes are relative to the five potential tool materials which they tested, i.e. basalt, siliceous limestone, chert, quartzite, and sandstone. This high variability can hardly be explained on the basis of the theory advanced earlier that rocks are structurally heterogeneous, even those that appear amorphous, and that their local characteristics, as measured at small points upon their surfaces, reflect this heterogeneity. In this case it would seem to be the strength of the whole sample that is the critical factor, even though the hammer that causes fracture does have a small (diameter *ca.* 2 mm.) striking surface. Certainly many more samples of each material would need to be tested, by the Paige method as well as by the other methods, before the limits of the variability could be established and statistically significant means obtained.

The values reported in the summary table suggest that limestone is the least tough and that silicified volcanic tuff is the toughest of the series. On the basis of the root mean, the latter is approximately 2.5 times as tough as the former. Obsidian, second lowest of the group, is approximately 1.5 times as tough as limestone. Fossil wood, second highest, is 2.2 times as tough as limestone. Quartzite, chert, and flints

[14] Goldbeck and Jackson, 1912.

III, II, and I, in the order of their increasing toughness, fall between these limits.

The authors of the study published by the Bureau of Public Roads arbitrarily categorized their Paige readings as follows: below 13, low; 13 to 19, medium; above 19, high. The Paige mean, drawn from their readings on all the materials they called chert, is 11.5, as compared with 10 for the material called chert in this study. Their chert mean, however, might equally well be compared with the flint means of 10, 11.90, and 13.82. Their mean for quartzite is 15; that obtained in this investigation is 10. Their work unfortunately included no others of the materials tested in this study. But it is interesting that among the many road materials they studied, only basalt, with a mean of 21.5, falls in their "high" toughness category. Of the materials in this series, flint I, fossil wood, and silicified tuff fall in the "medium" category, while chert and flints II and III might be said to be high in the "low" category.

This test was believed particularly relevant to the measurement of properties having significance in percussion flaking and the use of percussion tools such as hammers and axes. It is perhaps truly indicative that obsidian is low in toughness, according to this test. It seems reasonable to assume a correlation between the behavior of obsidian under the hammer with its behavior as seen in the other operational procedures. The particular quartzite used in this investigation was of a rather glassy appearance, and its low toughness might be regarded as correlated with this characteristic, as it appears to be in obsidian. The same theory might be expanded to explain the high toughness of silicified volcanic tuff, which was the least "glassy" of this group of materials. But, however interesting such speculation might be, the fact is that no conclusions can be drawn until many more measurements on these and other materials have been made.

The physical testing just described constituted the major portion of this investigation, but two other approaches to the definition of the physical properties of the materials were also utilized to some extent. These were (1) actual use of the materials in the making of tools, and (2) high-speed photographic records of this activity.

It was the good fortune of the writer that an expert flint-worker, Mr. Fred Armstrong, was interested in this study and was anxious to cooperate. It was hoped that samples of the same series of materials subjected to physical testing might be submitted to him for experimental tool-making. Undoubtedly his impressions of the nature of each would have been of great value in amplifying and interpreting the other evidence. Owing to the exigencies of the war, however, it was impossible to carry out this program, since Mr. Armstrong was early called into

the service. He was able to make many tools of East Anglian flint, and some of quartzite, but unfortunately no report on this work is available.[15]

It was hoped that, through the utilization of Professor Edgerton's highly refined photographic techniques, new information could be gained concerning what actually happens when a flake is detached from flint by percussion or pressure. In a series of twenty-nine stills which Professor Edgerton made of Mr. Armstrong's work, exposures were 1/50,000 second or less, and the exposure was made nearly simultaneously with the striking of the flaking blow. This was made possible by working in semi-darkness with the shutter of the camera open and the sound of the blow (picked up by a microphone held within a few inches of the work)[16] tripping the lights to expose the plate. Thus the time elapsing between the fall of the hammerstone and the exposure is only that required to transmit the sound to the microphone and the impulse to the light switch. Some concept of the speed of flint fracture is to be gained by an examination of the series of photographs so made. Only one of these can be reproduced here (See Pl. XXXVI). This example is, however, quite typical of the group. It shows the flake completely detached, though not yet far removed from the nucleus.

Even more illuminating in regard to the time element involved in flint fracture was a short moving picture sequence also made by Professor Edgerton. The photographic technique was fundamentally the same: the camera shutter remained open and frames were exposed by flashes of light of high intensity and of a duration of approximately 1/50,000 second. At the critical section of the film, i.e. that showing the blow, the film was traveling through the camera at a rate of thirty-nine feet per second, and 540 frames per second were being exposed. Hence the time elapsed between frames was 1/540 second. But the sequence of pictures clearly shows that the entire fracture, of about 2½ inches, occurred in less than this length of time. In one frame the hammerstone may be seen not quite in contact with the nucleus, while in the succeeding frame the fracture is complete and the flake well parted from the nucleus. Obviously only a fraction of the elapsed time between frames was required to produce the fracture. Without more studies of this nature no exact statements as to the velocity of flint fracture can be made. In view of this limited evidence, however, it would appear that this velocity is approximately that of glass fracture. Professor Edgerton,

[15] Other than the evidence of the high-speed photographs of this work, taken by Professor Harold E. Edgerton of the Department of Electrical Engineering of the Massachusetts Institute of Technology. For Professor Edgerton's time, interest, and generous cooperation, the sincere gratitude of the author is extended.

[16] See Pl. XXXVI.

by a series of elaborate photographic studies,[17] has demonstrated that the cracking speed of glass is about five thousand feet per second, and has shown that the rate of cracking is independent of the rate of application of the breaking force.

CONCLUSION

It should be clearly understood that the writer labors under no illusions concerning the practical value of the limited number of measurements made and reported here. These measurements, taken by themselves, have little or no meaning. But it is believed that this study represents an incursion into a neglected field which is of potential value to the archaeologist. To develop this field, all of the general types of rocks and minerals utilized in tool-making in all of man's history should be similarly studied, and many samples of each type would need to be scrutinized before statistically significant results could be achieved. Furthermore, the techniques of measurement used in this investigation should be changed, improved, and amplified in many ways. Improvements need to be made in the method of preparing the samples, in order that they may be cut at approximately the same low cost but with much greater efficiency. A wider variety of tests and testing devices should be developed and employed, and a petrographic analysis of each sample should be made, with photomicrographs for later study and comparison. Aside from these and other elaborations of laboratory procedure, the manipulative and subjective evaluation of each material should not be neglected. A competent and experienced knapper, preferably an archaeologist, should collaborate in an attempt to manufacture a given range of tool types from each of the materials tested in the laboratory. A record of the results in terms of the tools made, plus the workers' subjective impressions of the properties of the various materials, would be a valuable supplement to information gained otherwise.

It is believed that out of such a large-scale study might come a body of data of such reliability and comprehensive nature as to be of real utility to the archaeologist attempting to marshall *all* the evidence upon a given problem. A secondary, though perhaps almost as utilitarian, value of such a body of data would be the possibility of its use as a basis for the definition and classification of materials used for stone tools. A vast amount of confusion exists in archaeological literature because of the vague usage of such common terms as "flint," "chert," "chalcedony," etc. A certain august body of geologists has defined "chert" as "flint utilized in the making of stone tools." If no better definition can be given, then the term has no separate mineralogical

[17] See Edgerton and Killian, 1939, pp. 150–155.

meaning and hence *no* meaning, in the sense of carrying connotations concerning the physical identity of the material. Others have distinguished flint and chert on the basis of color, macro-structure, geological origin and distribution, etc. These classifications may be wholly adequate for the purposes of the geologist, who has little reason to be interested in these very rocks that most engage the attention of the archaeologist but to the latter a classification in terms of properties relevant to tool-making could be of considerable practical value.

This investigation is certainly upon what Kluckhohn[18] has referred to as the lowest level of a "hierarchy of abstractions" into which types of intellectual activity may be divided; that is, "technique," or "a highly concrete systematization of principles for dealing with a particular aspect of a particular subject." It is hoped that, on this level, there has been indicated a point of departure and a kind of operational procedure which might be much more fully developed. In regard to the "particular aspect," i.e. the technology of stone tools, of the "particular subject," i.e. archaeology, we hope we have demonstrated (1) that much factual evidence concerning the properties of stone tool materials needs to be gathered, and (2) that the archaeologist, by availing himself of some of the tools of the natural sciences and by pursuing the operational method, can build up this body of data. Upon the level of Kluckhohn's next highest order of abstraction, "method," we venture to suggest that by making detailed analyses of the properties of materials *in general* (not only of stone), the archaeologist may be able to add another tool to his already extensive kit. Such a tool, wielded effectively, even though in but one small sector of the total task of solving the problems of cultural history, may be found to serve its limited function with a precision greater than any other tools already in the kit.

It should be emphasized that, in the opinion of the writer, both *extensive* and *intensive* studies of artifact materials should be made as time, resources, and the interests of individuals permit. This should be done with a view to illuminating the whole broad question of the *degree to which the nature of the material in his hand may have guided or limited the work done upon that material by the artisan.*

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[18] Kluckhohn, 1940, pp. 41–45.

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Radcliffe College
Cambridge, Massachusetts
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TABULATED RESULTS OF TESTS ON STONE TOOL MATERIALS

DENSITY

Mass in gm. divided by volume in cc.

Material	*No. of Samples*	*Range*	*Mean*
Obsidian	3	2.30–2.52	2.42
Silicified Tuff	1		2.47
Fossil Wood	1		2.53
Flint I	9	2.51–2.65	2.58
Flint III	3	2.58–2.59	2.58
Chert	2	2.58–2.62	2.60
Limestone	1		2.63
Quartzite	2	2.63–2.69	2.66
Flint II	13	2.54–2.89	2.66

HARDNESS

Measured by the Rockwell Superficial Hardness Tester, in terms of the depth of penetration in arbitrary units of a sphero-conical diamond point under a load of 15 kg.

Material	*No. of Samples**	*Range*	*Mean*
Limestone	1	24–40	33.3
Silicified Tuff	1	75–94	87.6
Obsidian	3	58–96	89.1
Quartzite	2	80–96	92.1
Chert	2	84–96	92.3
Fossil Wood	1	91.5–95.5	93.3
Flint II	13	88–96.5	94.9
Flint I	9	92–98	95.0
Flint III	3	94.5–96	95.4

* Average number of measurements per sample: 5.1.

Mr. Armstrong using a natural pebble as a hammer stone to remove a thin flake from a previously prepared nodule of East Anglian flint. Just above the nodule may be seen the microphone used to transmit the sound of the blow to the light switch. (*Photograph by Professor Edgerton.*)

UNIV. OF MICH.

HARDNESS

Measured by the Shore Monotron, in terms of kg. load required to produce penetrations of $\frac{5}{5000}$ and $\frac{10}{5000}$ inches

Material	*No. of Samples**	*Range at 5/5000"*	*Mean at 5/5000"*	*Range at 10/5000"*	*Mean at 10/5000"*
Limestone	1	7–9	8		
Obsidian	3	16–38	24.9		
Silicified Tuff	1	29–32	30.7	61–64	62.5
Fossil Wood	1	25–39	32.1	57–78	67.0
Chert	2	23–40	33.9	46–76	66.7
Quartzite	2	30–40	34.3		
Flint I	9	24–47	36.5	58–89	71.8
Flint II	13	23–68	37.9	52–104	72.3
Flint III	3	32.5–43	38.1	68–84	73.6

* Average number of measurements per sample: 4.75.

RESILIENCY

Measured by the Shore Scleroscope, in terms of the rebound of a diamond-tipped hammer from the plane surface of the sample

Material	*No. of Samples**	*Range*	*Mean*
Limestone	1	41–71	52.0
Silicified Tuff	1	64–105	88.5
Fossil Wood	1	70–107	97.7
Quartzite	2	70–111	98.3
Chert	2	93–111	99.6
Flint II	13	73–121	102.1
Flint I	9	53–120	103.4
Flint III	3	79–122	105.1
Obsidian	3	101–121	110.2

* Average number of measurements per sample: 21.6.

TOUGHNESS

Measured by the Paige Impact Tester, in terms of height of the fall (in cm.) of a steel hammer which results in fracture of the sample.

Material	*No. of Samples*	*Range*	*Root Range**	*Root Mean*	*Paige Mean†*
Limestone	1			1.73	3
Obsidian	3	3–10	1.7–3.2	2.57	6.94
Quartzite	2	5–11	2.2–3.3	2.78	7.72
Chert	2	6–15	2.5–3.9	3.16	10
Flint III	3	6–15	2.5–3.9	3.16	10
Flint II	13	6–19	2.5–4.4	3.45	11.90
Flint I	9	9–21	3.0–4.6	3.72	13.82
Fossil Wood	1			4.00	16
Silicified Tuff	1			4.36	19

* Obtained by taking the square root of each measurement.
† Obtained by squaring the root mean.

ADOBE BRICKS IN A PRE-SPANISH WALL NEAR AZTEC, NEW MEXICO

EARL H. MORRIS

FOR a full thousand years before the conquest, peoples of the Pueblo area of the American Southwest manipulated adobe clay to meet their architectural needs with marked cleverness and skill. In the dim beginning, they used it to stop the cracks of their slab-lined storage cists against rodents and trickling sand. Later, they applied stout crusts of it over the thatch that covered the pole walls and roofs of their single-roomed dwellings. Later still, they learned to make independent walls of it. Usually these were built up layer by layer much as were pottery vessels of the day. But occasionally they were made of "turtlebacks," which, though of pure clay in rare instances, customarily consisted of a core of twigs or other vegetation encased in mud. At their architectural zenith, the Pueblo raised massive adobe structures of pisé-like appearance in localities where good stone was absent or hard to obtain and used it universally for mortar in stone construction, as well as for floors, plaster and roof covering. Yet during the entire millennium it seems almost never to have occurred to an aboriginal builder to fashion wet clay into units of definite size and shape which, when dried in the sun, could be laid up like building stones—a practice old in Sumeria by 3500 B.C. and employed in Egypt before the First Dynasty.

There seems to be but one record from the Pueblo area of the presence of sun-dried bricks in a wall unquestionably of pre-Spanish date. Dr. Fewkes states that they were found in both standing and fallen walls of the Speaker Chief's House in Cliff Palace, Mesa Verde. "These bricks were made cubical in form before laying, but there is nothing to prove that they were molded in forms or frames, nor do they have a core of straw. . . ."[1] Further description of the bricks is not given, nor is it indicated whether certain walls were made wholly of adobes or whether the latter were interspersed among the customary building stones. The following paragraphs describe in some detail an instance of Pueblo adobe-brick construction observed not far from Mesa Verde.

Until the last quarter-century there stood upon the north bank of the Animas River, about three-eighths of a mile south of the west end of what is now the Aztec Ruin National Monument, a high mound covering the remains of a pueblo estimated to have contained between thirty and fifty rooms in the first story. Demolition of this barrier to agriculture was underway before I began to take an active interest in

[1] Fewkes, 1911, p. 30.

the ruins near Aztec and was carried on piecemeal during the winters until 1918, when the site finally was brought to the level of the surrounding field.

Very little stone had been used in the construction of the building. Most of the walls were composed of clay in large blocks, made in situ, which ran in more or less horizontal courses. The method of their fashioning was one in use as early as Basketmaker III, and widely practiced in later times, it may safely be said, wherever walls exclusively of adobe were raised in the Pueblo area. To form a unit of such a wall, mud was added to the previously existent surface by gobs and handfuls and kneaded down, increment by increment, to form a more or less homogeneous mass until a block of the size determined upon had been shaped. The faces were smoothed, and the block was then left to dry and harden before the weight of another was added on top of it. In the ruin in question, some of the units are said to have been as much as 5 feet in length, 3 feet in height, and 15 to 18 inches thick.

Mr. Sherman Howe, an unusually keen observer of things archaeological in the Aztec neighborhood, stated that some of the walls razed during my absence had been built of sun-dried bricks. As a result of the discussion which followed this information, Mr. Howe informed me that more bricks had been found at ground level when the removal of the ruin had been practically completed. They proved to be present in the walls of two kivas, each about 16 feet in diameter. An arc on the north side of the one that had been least affected by moisture was laid bare. The upper seven courses of this wall are shown in Plate XXXVII, *a* with the plaster peeled away and the mortar scratched out of the joints over most of the area to bring the individual bricks into relief. At the left, the plaster remains to its full thickness at the bottom, but toward the top some of it is flaked off to show the successive coats.

Plate XXXVIII, *11* is a longitudinal view looking down upon this wall after the earth had been removed from both sides of it. It was almost uniformly 1½ feet in thickness. The inner face had been laid by an experienced mason, each block having been skilfully aligned to conform to the curve of the kiva circle. The outer face was somewhat irregular. However, since the space between the wall and the uneven bank of the kiva pit was to be filled with earth, there would have been no purpose either in aligning or smoothing the exterior.

As may be seen from the photographs, the bricks were laid in a great deal of mortar. Rarely was the latter less than one inch thick in the horizontal joints, and often it was nearer three than two inches thick in the vertical ones. Every fourth course consisted of headers, that is, of bricks laid crosswise of the wall to bond the face securely to

the core (Pl. XXXVII, *b*). This feature was most surprising because of its contrast to the hit-and-miss bonding characteristic of Pueblo masonry in the San Juan area. Never have I seen another example of it done in so consistent and formal a manner. Ordinarily, where bonds occur at all, they seem to have been placed at random, wherever it occurred to the individual mason that it might be well to insert one, but here they were placed with a regularity that would suggest a definite rule of the trade. All bricks composing the inner face of the wall were entire when laid, but the core and the backing contained nothing but broken pieces or bats.

Ten of the bricks selected as a representative series, are shown in Plate XXXVIII, *1–10*. The dimensions of these are:

	Length in inches	*Width in inches*	*Thickness in inches*
1.	12	5½	3
2.	10	5¾	3½
3.	8	4¾	3½
4.	8¾	5½	3½
5.	9¼	5¾	3½
6.	8¾	5	3
7.	7	4½	3½
8.	7½	4½	2¾
9.	6¾	3¾	2¾
10.	5½	3½	2½

In all cases the measurements represent the maxima. As may be judged from the photographs, the bricks, while essentially rectangular, are not squared blocks. Commonly, from the bottom they slope upward and inward, and the top and corners are slightly rounded. It is not difficult to reconstruct the process of their manufacture. A surface of smoothed earth served as a molding table. Upon it the stiff clay was thumped and pressed to an approximation of the desired shape, without the use of form or mold other than the hands of the workman. Evidently the clay had been well mixed, because each brick is fairly homogeneous throughout, with no variation in internal structure such as would have resulted from only partial kneading of the paste.

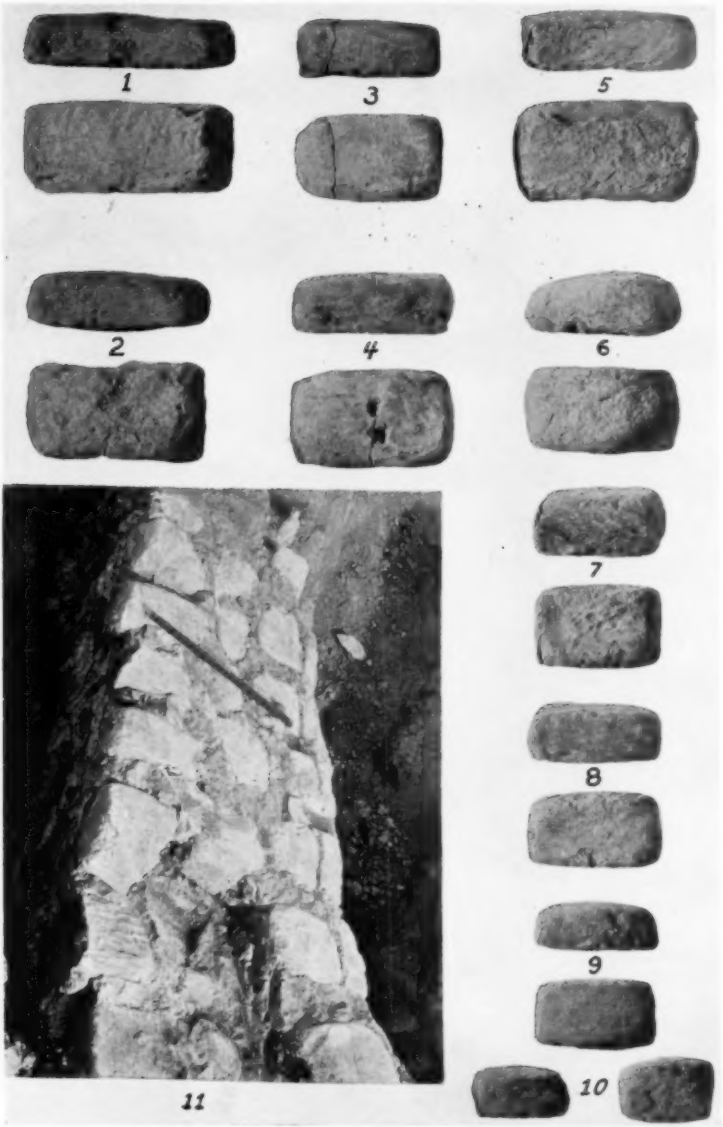
Two kinds of surface finish can be distinguished. On a great majority of the blocks, fingerprints are plainly visible; in some cases they are the result of direct pressure, in others they are made with a long drawing motion. A few, however, have wiped surfaces (Pl. XXXVIII, *2, 9*) such as would be produced by a grainy paddle or by a rag held over fingers worn thin by too frequent contact with the clay.

The material utilized was a dark brown-gray adobe soil of great hardness when dry. It contains no temper or vegetable binder whatever. Evidently the earth used was freshly dug, since it is characteristi-

a

b

Views of adobe kiva wall. *a*, seven courses of the adobe kiva wall. Plaster remains to full thickness at lower left but is peeled off over most of the area to show individual bricks. *2* and *6* are header courses. *b*, close-up showing arrangement of bricks in header course. The same brick is marked *2* in both photographs.



Adobe kiva wall and adobe bricks. *1–10*, side and top views of a representative series of the bricks. *11*, longitudinal view of adobe kiva wall showing rough exterior, use of bats for core and backing, and wide joints. A settling crack runs across the headers in the face course at the right (course *6* in Pl. XXXVII, *a*).

cally free of adulteration. In a very few of the broken specimens, a negligible number of charcoal flecks were visible. But there is no reason for assuming that these were intentionally introduced. Charcoal was always present everywhere in the neighborhood of the ancient dwellings, and it would have been very difficult to keep blocks, molded on the ground, entirely free of it. Adobe of the same quality occurs as subsoil beneath the ruin. Hence it is not improbable that the earth for their manufacture was taken from the pit in which the kiva was to be built.

There is good reason to believe that the making of adobe bricks was tried in at least one other instance in the Aztec vicinity. The late H. D. Abrams, last private owner of the Aztec Ruin, told me that, when he cut into the long low rampart that parallels the north side of the eastern one of the two great pueblos of the Aztec group, he observed, among the debris removed, many adobe bricks like those described. The purpose of his excavation was to level the area preparatory to the erection of a huge hay barn there. This barn was moved under a PWA project in the winter of 1933–34 and the drift which had been dug for its south end was filled up. While the drift was open I was, unfortunately, not present to examine the bricks first-hand and to find out in what sort of construction they had been used.

Since the making of molded bricks did not become a common practice, the instance here recorded probably should be regarded as an experiment. That it was considered a failure may be judged from the fact that only the face course, or veneer of the wall, contained whole bricks, whereas the remainder was composed entirely of fragments. The wall would have averaged three bricks in thickness. Thus, without making allowance for broken ones that may not have been used at all, at least two-thirds of the bricks were in fragments before they found their place in the wall. The cause of the failure is obvious. Rich adobe clay, when used either as mortar or as the substance for bricks, is subject to great shrinkage as it dries. While it is intensely hard after the moisture has left it, it will almost invariably check and separate into small angular pieces before the drying, however slow, is complete. To overcome this tendency, the clay must be diluted with a considerable amount of sand, or be mixed with straw or a similar vegetable reinforcement; neither of these measures was taken in the case in question. This shows how completely the Pueblo masons—at least those who fashioned these bricks—had forgotten the wisdom of their ancestors in the trade, ancestors, who, during Basketmaker III and Pueblo I, rarely failed to temper their adobe with shredded juniper bark, corn tassels, grass stems or some similar material.

Judd's conclusion that the Pueblo never made form-molded bricks

nor bricks of fixed dimensions until they were taught how to do so by the Spaniards would seem to be valid still.[2] Nevertheless, the presence of these hand-molded blocks, which lack only the qualification of uniform dimensions to make them bricks in every sense of the word, fosters the belief that, had the experiment which produced them not been adjudged a failure, brick-making as a source of building material of convenient size and shape would soon have come into vogue. And had the practice become general, presumably the short step between hand- and form-molding soon would have been taken.

The time at which these bricks were made can be fixed within fairly narrow limits. The pottery associated with them is identical to that in use when the West Pueblo of the Aztec group was built. The tree-ring dates given by Dr. Douglas for the construction of the West Pueblo are A.D. 1110–1121.[3] Another ruin, containing the same pottery complex, and situated about one-eighth mile southwest of the one where the bricks occurred, has been dated. Excavation for the north end of the Estes Arroyo bridge, at the point where the road to the Aztec Ruin National Monument leaves the highway, cut across a kiva in which were large timbers, charred but sound. Mr. T. C. Miller, Custodian of the National Monument, took sections of five of them which were subsequently submitted to Mr. Harold S. Gladwin. Four of the five sections were found to be datable by Mr. Gladwin. The outside ring of one specimen represents the year A.D. 1091; that of another, the year A.D. 1096; and those of the two remaining specimens, the year A.D. 1097.[4] Thus, the kiva from which they came could not have been built before 1097. Assuming that this was the year of its construction, that the ruin which yielded the bricks was practically contemporaneous, and that the West Pueblo of the Aztec group is slightly later, the conclusion that the hand-molded adobe bricks were made between A.D. 1090 and 1110 cannot be far wrong.

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Boulder, Colorado
December, 1942

[2] Judd, 1916, p. 242. [3] Douglass, 1929. Map on p. 743.
[4] Personal communication, November 24, 1942.

HERMANN BEYER

ROBERT WAUCHOPE

DR. HERMANN BEYER, on leave of absence from the Middle American Research Institute of the Tulane University of Louisiana, where he had been Associate in Archaeology since 1927, died December 6, 1942 at the Station Hospital, Stringtown Army Internment Camp, Stringtown, Oklahoma.

Dr. Beyer was one of the world's outstanding scholars in the field of Middle American hieroglyphic studies. He received an honorary degree of Doctor of Philosophy from the University of Würzburg, Germany, in 1932. He was founder and past editor of *Mexico Antiguo*, and had been Honorary President of the Deutsch-Mexicanistische Vereinung, Mexico City, and Honorary President of the Museo Nacional de Mexico. He was a member of the New Orleans chapter of Sigma Xi fraternity, Academia Nacional de Ciencias "Antonio Alzate," Mexico, the American Anthropological Association, and the International Congress of Americanists. He attended the 1938 Copenhagen meetings of the last-named society, and the 1939 meetings in Mexico City. He was an honorary member of the Verein für Völkerkunde of Dresden, Germany, a corresponding member of Geographische Gesellschaft zu Würzburg, and the Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, Berlin. Dr. Beyer was also a Fellow of the American Association for the Advancement of Science.

Dr. Beyer studied in Germany in 1930 under a Social Science Research Council Fellowship, and in 1932 conducted a study of Maya inscriptions at Chichen Itza, Yucatan, under a Rockefeller grant. In 1938 he studied museums in Central Europe under a fellowship of the Oberlaender Trust of the Carl Schurz Foundation.

He was a voluminous writer and published some 166 articles. A full bibliography appeared in the *Boletin Bibliografico de Antropologia Americana*, Vol. 5, 1941, pp. 167–175. Those titles referring to Maya subjects appeared in the bibliography accompanying *The Inscriptions of Peten*, by Sylvanus Griswold Morley.

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The Tulane University of Louisiana
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THE THIRD ROUND TABLE CONFERENCE

The Third Round Table Conference of the Sociedad Mexicana de Antropología was held in the Castle of Chapultepec in Mexico City from August 25 to September 2, 1943. Fifty-one persons participated in the discussions, and many students and other interested persons attended. Twenty of the participants were from the United States, an unexpected and gratifyingly large delegation considering the difficulties of wartime travel and the many persons engaged in war activities. In normal times, as Dr. Haury pointed out in a message of greeting from the Society for American Archaeology to the Mexican Society at the opening meeting, a great many more American anthropologists could have been expected to attend.

The discussion this year concerned the many and important problems of Northern Mexico and those of the relationships between Middle America and the cultures of the Southeast and Southwest of the United States, problems of vital interest to workers on both sides of the border. This is an area or field of research which can be successfully attacked only through the combined efforts of Mexican and United States anthropologists, and the Mexican Anthropological Society deserves much credit for initiating the attack through this conference. It has served to focus attention on a neglected area of North America, to define many of the problems awaiting solution, and, above all, to make both Americans and Mexicans more aware of the materials, problems, and methods of research in the other's country.

The Round Table Conferences of the Sociedad Mexicana de Antropología have attained within a short period a recognized place of importance in Middle American anthropology. Each conference is devoted to a single important area or problem, which is discussed from all angles by specialists in the various branches of anthropology, resulting in broad definitions of problems or generally acceptable conclusions. The great success of the conferences springs from the enthusiasm and ability of the present generation of Mexican anthropologists and historians, who are developing the science of anthropology in their country at an enviable rate.

The subject up for discussion at this meeting was phrased as follows: Northern Mexico and the relationship between the cultures of Middle America and those of the Southeast and Southwest of the United States.

At the opening meeting A. V. Kidder and Alfonso Caso were elected presidents of the conference and Rubín de la Borbolla and Jorge Vivó, secretaries. The program of discussions was finally arranged and proceeded as follows:

I. Northern Mexico
  1. The Geographic Setting, by Jorge A. Vivó.
  2. Colonial History of the Indians.
    a) The Chichimecas (Querétaro, Guanajuato, Eastern Jalisco, Zacatecas), by W. Jiménez Moreno and Miguel Orthón de Mendizabal.
    b) Eastern Nueva Vizcaya, by A. G. Saravia.
    c) Nuevo Santander, by G. Saldivar.
    d) The Indian Slaves of Northern Mexico, by Silvio Zavala.
  3. Ethnography and Linguistics
    a) The Northern Provinces of the Mexican Empire, by Robert Barlow.
    b) Tribes and Languages, by W. Jiménez Moreno.
    c) Culture Elements and Culture Areas, by Paul Kirchhoff.
  4. Archaeology
    a) Northern Mexico, by Carlos Margáin, Wilfrido Du Solier, and Eduardo Noguera.
    b) Texas, by Alex Krieger.

Summary of the First Section, by Paul Kirchhoff.

II. Summaries of Early Man, Physical Anthropology, and Linguistics in Northern Mexico and the Three Surrounding Areas.
   1. Early Man, by Pablo Martínez del Río.
   2. Physical Anthropology, by Daniel F. Rubín de la Borbolla.
   3. Varieties of Prehistoric Indians of the Eastern United States, by Georg Neumann.
   4. Linguistics, by Robert Weitlaner, Alfredo Barrera Vasquez, and J. Alden Mason.

III. Cultural Relationships between Northern Mexico and the Surrounding Areas.
   1. Northern Mexico and the Southwest of the United States.
      a) Ethnology, by Ralph Beals.
      b) Archaeology, by Donald Brand, Emil Haury, and Isabel Kelly.
   2. Northern Mexico and the Southwest of the United States in Relation to Middle America.
      a) Archaeology, by Ignacio Marquina, A. V. Kidder, and Ralph Beals.
      b) Ethnology, by Paul Kirchhoff.

   Summary by Ralph Beals and Emil Haury.

IV. Relationship between Middle America and the Southeast of the United States.
   1. Ethnology, by John R. Swanton.
   2. Archaeology, by James B. Griffin, Gordon Ekholm, and Wigberto Jiménez Moreno.

   Summary by J. Alden Mason.

V. Chronology and Dendrochronology.

   Discussions by E. Schulman and Emil Haury.
   Discussions by Gordon Ekholm, J. B. Griffin, Alfonso Caso, and Herbert J. Spinden.

VI. General Discussions.
   1. Selection of a subject for the Fourth Conference.
   2. Election of the Organizing Committee for the Fourth Conference.
   3. General Business.

Also included in the program were excursions to Tula and Teotihuacán, sites at which very important excavations are being carried on. These trips, including a luncheon en route to Tula, were offered to the conferées by the Instituto Nacional de Antropología. At Teotihuacán a banquet was given in the Grotto Restaurant by the Secretaria de Educacion Publica.

No attempt will be made here to review all of the papers and discussions presented during the seven full days of meetings; only certain of the most significant ones will be summarized in connection with a résumé of each of the four sections into which the conference was divided.

The first section was meant to define the area of Northern Mexico and to present the historical, ethnographical, and archaeological data concerning it. The various papers presented served to indicate that the term "Northern Mexico" can be taken as a label for the large area which was occupied at the time of the Spanish Conquest by peoples who were primarily hunters and food gatherers. It is the area of the low cultures which are basically distinct from the so-called high cultures in the surrounding areas of Mesoamerica, the Southeast, and the Southwest. Little attempt was made to define the northern boundary of this area, but there was much discussion concerned with the drawing of a line to mark off the area of Northern Mexico from that of the high culture area of Mesoamerica to the south. There were differences of opinion, but it was generally agreed that this line of division begins on the east coast just north of the Huastec area in southern Tamaulipas, bends southward on the Central Highlands to form a great pocket which includes the area of the Pame, Guachichiles, and Zacatecos, and then runs northwestward through the states of Zacatecas and Durango.

Perhaps the most important points from the résumé of this section which were accepted by the conference will best indicate the trend of the discussions.

It was seen that no new data exist on the archaeology of the area of the non-agri-

cultural peoples of Northern Mexico. Unfortunately the results of the recent investigations by Walter Taylor in the caves of Coahuila were not available.

Carlos Margáin and Eduardo Noguera reported on certain recent excavations at a number of the so-called frontier sites, including La Quemada, Las Ventanas, and El Tuel, the pottery from which relates to Mazapan and Aztec II, III. It was emphasized that these sites are found on the tops of hills and are in the nature of fortresses.

The recent explorations of Du Solier and Ekholm were reported as indicating a long sequence of cultures in the area known historically as the Huasteca, all of the cultures in the sequence being in the tradition of Mesoamerica. There is also evidence that the Huastec cultures extended as far west as the city of San Luis Potosí at a time tentatively placed as corresponding to Teotihuacán IV–Aztec I.

Robert Barlow reported new investigations based on the *Matricula de Tributos* and other documents which offered more precision in fixing the frontier between the Mexican Empire and the primitive peoples of Northern Mexico.

On the basis of various historic and ethnographic studies presented, it was generally agreed that there was a basic uniformity of culture among the nomadic peoples of Northern Mexico, constituting a cultural area. This view was summarized by Kirchhoff, who also divided this large area into five sub-areas as follows:

1) *Pame.* In this area were marked Mesoamerican influences and probably a slight amount of rudimentary agriculture.

2) *Southern Tamaulipas.* Here the Mesoamerican influences were in the realm of material culture only: agriculture, pottery, etc.

3) *Guachichil.* In this area are found cultural characteristics which are distinctive as concerns the nomads of Northern Mexico as a whole and also influences from Mesoamerica different from those in the previously mentioned sub-areas.

4) *Zacateca.* This sub-area is tentatively established on somewhat questionable data.

5) *de los Rayados.* This sub-area includes a great number of small tribes in the northern part of the North Mexican area. The name comes from the custom of distinguishing tribal units by various types of painting on the head and body. Within this sub-area the region of La Laguna, where there is some evidence of agriculture, may be an exception.

In this section of the conference the contributions of the historians were of especial importance, for most aboriginal groups have entirely disappeared and ethnographic data are primarily a product of historical research.

The second section was devoted to papers summarizing certain broad fields of anthropology to serve as background for the more specific discussions. Pablo Martínez del Rio covered the field of early man, pointing out the almost complete lack of data from Middle America and the probability that such will be found when it is systematically searched for. A. V. Kidder described the finds of early footprints in Nicaragua as part of the lively discussion following Martínez del Rio's paper. A more or less even-sided difference of opinion was expressed as to where to search for early remains, along the coasts or in the Central Plateau. Borbolla summarized the very meager material and data available on the physical anthropology of Northern Mexico and showed that it was entirely inadequate for any appraisal of the racial history of the area. Georg Neumann described the methods which have been used so successfully in the study of the archaeological skeletal material in the eastern United States.

The papers and resulting discussions listed in Sections III to V of the program might perhaps be summarized under two headings, (1) the Southwest and Mesoamerica and (2) the Southeast and Mesoamerica. Only the papers presented by Beals and Kirchhoff dealt specifically with Northern Mexico in relation to the surrounding areas.

Beals advanced a proposal to extend our concept of the Southwest to include the

area of the hunting peoples of Northern Mexico, the farming peoples of the Sierra south to the Cora and Huichol, and the coastal peoples as far south as northern Sinaloa. The northern limits of such an area would include the basin region and the southern part of the Californias. The name "Arid North America" was proposed, but alternatives offered in discussions included "The American Southwest" and "Greater Southwest," none of which was generally acceptable. This proposal was offered with reference especially to ethnological data, but it may be applicable to archaeological data as well. Kirchhoff elaborated Beals' proposal by pointing out that the food gatherers of Northern Mexico possessed a number of characteristics in common with similar peoples in the Great Basin and other parts of this "Greater Southwest," as well as traits which only recur among simple peoples of South America. The culture of the nomadic peoples of the "Greater Southwest" is of an archaic character. The Mesoamerican influences which reached the Southwest by-passed the hunting-gathering peoples of Northern Mexico, and were probably transmitted through the farming peoples of western and northwestern Mexico.

It was generally agreed that the Southwest received cultural stimuli from Mesoamerica at two distinct times. The first wave of influence took place at about 1 A.D and included corn, pottery, and figurines. The second wave of influence occurred, according to Haury, from 700 to 1400 A.D., when certain definite Mesoamerican elements such as ball courts, paint cloisonné-decorated mirrors, and copper ornaments reached the Southwest. Brand asserted that this second wave of influence occurred at about 700 A.D. and included the turkey, brachycephals, etc.

There was no general agreement as to the possible route of these influences up into the Southwest. Haury pointed out that the Mexican elements in the Southwest are concentrated in the Hohokam area and that diffusion up the Mexican West Coast would appear most probable. This was countered, however, by Isabel Kelly's pointing out that the Mesoamerican cultures of Sinaloa were too late in time to have served as a means of diffusion along this route. It was suggested that the route of diffusion may have been in the Highlands to the east of the Sierra Madre or, in the opinion of Dr. Brand, up the western foothills of the Sierra Madre.

Dr. Isabel Kelly presented a general analysis of studies in Michoacán, Colima, and Nayarit, showing that she has not found any early cultures in that area, i.e., none previous to approximately the Teotihuacán III horizon. Marquina indicated the basic differences between the architectural patterns of the Southwest and of Mexico, while A. V. Kidder expressed the opinion that more time should be allowed for the development of the Mesoamerican cultures than has been popular in recent years. The Middle American chronology must be brought downwards to correspond properly with the tree-ring dates of the Southwest.

Haury outlined the entire known sequence of cultures in the Southwest, both early and late. Schulman discussed tree-ring methods and expressed the opinion that tree-ring dating could probably be applied in Central Mexico.

In Section V, all the available data concerning relationships between the Southeast and Mesoamerica were presented, and the subject was discussed at length. Unfortunately, however, no new data of critical importance were presented, and little advance could be made toward the solution of the many problems involved in this field. The papers by Swanton and Jiménez Moreno were concerned primarily with the relationships seen in the ethnological material, and those of Griffin and Ekholm covered the archaeology. Griffin's contribution was especially valuable, for he summarized the archaeological history of the Southeast, providing background in a field which is inadequately known to most Middle American archaeologists.

It appeared to be generally accepted that there are many elements in the cultures

of the southeastern United States which must have had a Mexican origin. These are commonly known and will not be listed in full here. They include certain general resemblances such as corn agriculture, methods of cultivation, the building of mounds, and a tendency toward federation and the forming of "empires," all of which may have been the result of contact at a relatively early period. On the other hand, there are some very specific resemblances to Middle America in the late and elaborate art forms of the Southeast, in the copper repoussé plaques, shell gorgets, and engravings on pottery, and in the rectangular plans of ceremonial sites with pyramidal substructures. Several resemblances were discussed which have not previously been emphasized in the literature. One is the heart, skull, and hand motive which occurs on the engraved vessels from Etowah and is almost identical to that in the frescoes at Tizatlán, Tlaxcala, and in certain Cholula polychrome vessels. Another is the manner of depicting bones on these same vessels and in the Mexican codices.

The discussions revolved principally around the questions of how and when these Middle American elements reached the Southeast. Ekholm pointed out the vague resemblance between an early pottery complex of the Huasteca and the incised wares of the lower Mississippi Valley and the resemblance between the round shell gorgets of the Southeast and those of the Huasteca. He also showed that the Huasteca contained cultures sufficiently advanced from an early time up to the conquest to have served as a place of origin for movements into the Southeast. There was nothing conclusive in these suggestions, but the general opinion seemed to be, because of a lack of any other known route, that the route of influence into the Southeast was probably upward along the coast of Tamaulipas and Texas. The great objection to this possibility is, of course, the great distances involved through arid country which was occupied by more primitive nomadic peoples and where no relevant archaeologic materials have been found. The best explanation appears to be that, as the late Mexican influences in the Southeast were primarily of a religious-ceremonial nature and no trade objects have been found, the influences were the result of a small migrant group moving into the area.

The question as to when these contacts between the Middle American and Southeastern cultures occurred is as confused as the problem of how they occurred. The entire chronological column as seen at present in the Southeast would appear to be in general too short to fit in with that of Mexico. It is impossible to make close correlations between developments in the two areas, but it would seem unlikely that peripheral lag could account for the supposed lateness of elements in the Southeast corresponding to those of Mexico. The opinion of most persons at the conference who were looking at the Southeast from Mexico was that considerably more time would have to be allowed for the development of Southeastern culture than is conceded at the present time.

During the final meeting a subject was chosen for the Fourth Round Table Conference, to be held during the summer of 1944. It was decided to discuss the area of southwestern Mexico included in the basins of the Santiago and Balsas rivers.

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FACTS AND COMMENTS

AN INACCURATE DESCRIPTION OF MIDWESTERN TAXONOMY

For reasons best known to him, McGregor has included in his recent book on Southwestern archaeology a brief statement regarding the midwestern taxonomic method,[1] although this method is not used in the Southwest. The statement is in error on several fundamental points, and it seems important to publish a correction just to keep the record straight.

First: the interpretation of "diagnostic culture traits" as traits which are standard for a culture complex in all cultural comparisons (p. 61) is not in accord with the usual concept as employed in midwestern terminology. As originally proposed by Ritchie, and as previously pointed out in my review of Cole's and Deuel's *Rediscovering Illinois*, the diagnostic trait is determined by a specific comparison of two culture complexes, and applies only to a culture in that comparison. A trait which is diagnostic in one comparison may appear as a link trait in another, and so can not be generally diagnostic for a given culture complex in all comparisons.[2]

Second: the *component* is not the most detailed, localized class of culture in the taxonomic frame (pp. 61–62). In fact, it is not a term designating any separate class of culture, but is the manifestation of a *focus* (the most detailed class) at a site. Culturally, the various components of a given focus are identical to each other and to that focus. The term is used to distinguish between a site, which may yield data representative of several distinct cultures, and the manifestation of a specific cultural focus at that site.

Third: classes in the taxonomic frame are not determined by percentages of trait similarity (p. 62). Percentage identification was proposed in the early developmental period of experimentation and trial, but was never actually used, partly because culture traits do not have the same mathematical values—they are not quantitatively identical units in any mathematical sense—but primarily because this type of determinant was not needed. There has been no confusion over the allocation of a culture complex to its proper class. This is probably because taxonomy is resorted to only when circumstances require it; the problem is never that of classifying everything in sight. Classification starts with a focus, determined by the recurrence of the same detailed complex at site after site. There can be no question of the focal status if data are sufficient to warrant classification. Similarly, other foci are determined, and it may become clearly apparent in the course of comparative study that two or more foci are sufficiently alike to make practical their classification within the same aspect, that like aspects determine a phase, or that like phases determine a pattern. Once a pattern has been identified in terms of a complex of traits, a newly determined focus may immediately be recognized as within that pattern; the phase and aspect remain to be identified when accumulating data serve to indicate clearly the cultural relationship. In short, nothing is done until the type or degree of relationship is clearly apparent, and when this is apparent there remains no problem of type or degree of relationship.

The theoretical objection that it is difficult " . . . to visualize the various divisions suggested" (p. 61) is based probably upon the expectation that each of the type classes should correspond in character to some historically known type of social group: a local group, a tribe, or some other ethnological division of society or culture. Actually, the focus may sometimes parallel the tribe—depending upon the extent to which "tribe" is employed as a cultural term—and the other classes may sometimes parallel cultural divisions with such linguistic names as Iroquois or Chiwere, such ethno-geographic

[1] J. C. McGregor, *Southwestern Archaeology* (New York, John Wiley & Sons, Inc., 1941), pp. 60–62.
[2] AMERICAN ANTIQUITY, Vol. 3, No. 4, p. 369.

divisions as Central Eskimo, or the cultural variety represented in such a term as "culture area." Yet there can be no prevailing parallel between these strictly cultural types in archaeology and such ethnological divisions, based, as they are, on language alone, culture, political economy, geographical distribution, or even race, or on combinations of these factors.

Moreover, the midwestern taxonomic divisions certainly do not essentially represent politico-economic groups of people, any more than such groups are represented by the culture-area or sub-culture-area concepts, or by such linguistic concepts as Ojibwa, Algonkin, Chiwere, or Sioux. Rather, they represent cultural adaptations of traditional habits and concepts, as modified by environment, invention, and diffusion, and subject to limitations of space and time, as manifested by culture-indicative data itemized as traits.

The objection that these archaeological classes can not be visualized in terms of historical groups of people would apply equally well, in parallel, to the divisions in any scientific classification. After all, try to visualize in natural group concept a species, a genus, or an order; or, for that matter, try to visualize the Chiwere in terms other than a complex of linguistic traits, or the northern Plains Indians in terms other than a complex of culture traits. The problem of visualizing cultural divisions has not materialized in the practice of classifying the archaeological varieties on the basis of the comparison of trait complexes. The problem is not one of visualizing culture-bearing groups of people, but one of convenient organization of qualitative and quantitative facts in order to facilitate further progressive research. The "variable human element" is not vitally involved where the actual demonstration of the occurrence of traits in a complex is observed and recorded repeatedly by numerous students.

It seems a bit extraordinary that McGregor apparently experiences no difficulty in visualizing the difference between roots, stems, branches, and phases in the Gladwin taxonomic method (p. 62), none of which are determined on a percentage or similarly "exact" basis. The one fundamental difference between the midwestern and Gladwin methods is that the former employs the cultural factor alone, whereas the latter, theoretically, is based on cultural, temporal, and spatial factors, although actually classification is made repeatedly on cultural criteria alone before time and distribution can be determined.

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TIPONI, OR CORN GODDESS SYMBOLS

Among the less frequently encountered, yet widely distributed, items of material culture recovered in the Anasazi Province are *tiponi*, or Corn Goddess symbols.

In the excavation of the Evans Site in the Gallina region of northern New Mexico three *tiponi* were found.[1] Two, the largest and the smallest, were in the North House; the third was in the South House. All were of sandstone and were simply-fashioned cones, flat on one end and bluntly pointed on the other. Aside from their shape, no distinguishing features were discernible. The largest was 48 cm. in height and 20 cm. in basal diameter; the smallest was 18.4 cm. in height and 15.2 cm. in basal diameter.

The *tiponi* found in the South House was one of a number of miscellaneous stones which had been used as fill in the bottom of the fireplace or had fallen into the pit. The two from the North House were in the general fill in the vicinity of the fireplace, but no association could be determined. At Site Bg6, two miles from the Evans Site and also

[1] Charles H. Lange, Jr., "The Evans Site: A Contribution to the Archaeology of the Gallina Region, Northern New Mexico," M.A. Thesis, University of New Mexico, December, 1941, pp. 44–45, Pl. 20.

excavated in 1941, another *tiponi* was found, again in the fill near the fireplace. No other specimens have been reported from the Gallina region, but, from these indications, use of the *tiponi* near the smokehole above the fireplace might be postulated.

Tiponi have been noted in various papers on other areas in the Anasazi Province. From the Village of the Great Kivas, near Zuñi, Roberts reported their occurrence on a kiva floor, in several of the rooms, and also in the dumps.[2] The two specimens from the kiva were 22.1 cm. and 21.9 cm. in height and 19.7 cm. and 19.5 cm., respectively, in basal diameter. These had concave bases, presumably so that pollen might be placed beneath them.[3] Those from the Gallina had flat bases. Roberts' Zuñi workmen claimed that similar stones are usually placed at each side of the present-day Zuñi altars. They are also placed in cornfields to assure plentiful crops. At such times they are usually ornamented with beads and feathers and are sprinkled, from time to time, with sacred pollen.[4]

Morris described three similar specimens from the La Plata district.[5] Like Roberts, Morris called them Corn Goddess symbols and cited parallels in modern Hopi and Zuñi culture. The largest specimen found by Morris was 29.2 cm. high and 19 cm. in basal diameter. A small concavity was in the base, and a small pit had been made in the tip. These features were absent in the other two. All three were found in house wreckage. As in the case of the Gallina finds, definite data on their use were lacking.

Fewkes reported similar objects from Mesa Verde in the northwest corner of Kiva H at Cliff Palace,[6] referring to them as possibly idols of the Earth Goddess; others were found in Kiva B at Oak Tree House.[7] According to Fewkes, the Hopi call them Idols of Alosaka, or Muyinwu, the germ gods, or simply "corn mounds" (Kaetukwi), which are supposed to cause corn to germinate when it is planted. The Hopi also place these objects of stone, wood, or clay on the altar during the Powamu ceremony, the festival for the purification and renovation of the earth which is given each February. Fewkes also found one of these "corn mounds" in a grave at Sikyatki at the East Mesa.

Jeançon described *tiponi*, or prayer plume bases, in his Chama Valley report.[8] These objects were of clay. Prayer feathers were tied around the top and inserted into holes in the top. A mixture of clay and some black pigment, possibly ground slate and soot, was frequently used in these objects from the Jemez Plateau. While Jeançon has termed these *tiponi*, it appears their functions were of a nature somewhat different from those of the objects previously described in this paper. Jeançon also describes numerous cone stones, varying greatly in size and height.[9] They were invariably found in the fireplaces, and so they were termed firedogs or andirons. Practically all were of sandstone. The largest was 29.2 cm. in height and 14 cm. in basal diameter. They were usually in groups of three, and in one room (Room 8, Location 3) the remains of a black cooking pot were still on top of these andirons. While some of these stones are very similar in

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[2] Parsons (E. C. Parsons, "Relations Between Ethnology and Archaeology in the Southwest," AMERICAN ANTIQUITY, Vol. 5, No. 3, 1940, p. 15, note 329) pointed out that the pair in the kiva had been used as fetishes rather than as amulets, as indicated by the fact that they had been intentionally overturned to allow the Spirit to leave at the close of the ceremony.

[3] F. H. H. Roberts, Jr., *The Village of the Great Kivas on the Zuñi Reservation, New Mexico*, Bureau of American Ethnology, Bulletin 111, 1932, p. 61, Pl. 10, *b*. [4] *Ibid.*, p. 143, Pl. 55, *d*, *e*.

[5] E. H. Morris, *Archaeological Studies in the La Plata District, Southwestern Colorado and Northwestern New Mexico*, Carnegie Institution of Washington, Publication No. 519, 1939, pp. 129–130, Pl. 137, *b*.

[6] J. W. Fewkes, *Antiquities of the Mesa Verde National Park: Cliff Palace*, Bureau of American Ethnology, Bulletin 51, 1911, p. 67.

[7] J. W. Fewkes, "The Cliff-Ruins in Fewkes Canon, Mesa Verde National Park, Colorado," *Holmes Anniversary Volume*, 1916, p. 112.

[8] J. A. Jeançon, *Excavations in the Chama Valley, New Mexico*, Bureau of American Ethnology, Bulletin 81, 1923, p. 64, Pl. 21. [9] *Ibid.*, p. 24, Pl. 20, *d*.

appearance to the conical stone *tiponi*, the associations in which they were found indicate a different function. Andiron groups have been found in numerous ruins on the nearby Pajarito Plateau.[10]

In a later report,[11] Jeançon described and illustrated the use of four *tiponi* in a rectangular ceremonial room at Santa Clara Pueblo in 1926.[12] On the floor along each of the four walls was an altar with a sandstone cone as the principal item. The lower portion of each cone was covered with a grass skirt. In winter, pine-twig skirts were substituted. Black slit-eyes were painted near the top; mouth and nose were not indicated. Each cone was painted a directional color, white (east), blue (north), yellow (west), or red (south). It should be pointed out that this series differs from the list of directional colors given for the Rio Grande pueblos elsewhere in the same article by Jeançon. These are white (east), red (north), blue (west), and yellow (south). This series is incorrect, however, since the Tewa pueblos have a series of their own, as evidenced by these Santa Clara *tiponi*, which is different from that of other Rio Grande pueblos.[13]

The distribution of *tiponi*, from the Hopi country in the west to the Rio Grande in the east, extends across the northern Anasazi area. Chronologically, they occur from 1000 A.D. almost continuously to the present time. Undoubtedly other instances exist within this area and time-range, and additional finds may well extend the limits as they are now known. The occurrence of *tiponi* adds to the ever-increasing number of parallels in the archaeology and ethnology of the Southwest.

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CORN GODDESSES OR PHALLI?

While attending the 1941 summer field session of the University of New Mexico at Chaco Canyon, the author hired four Navahos and partially excavated a small pueblo site on the talus about one-third of a mile up the valley from Chetro Ketl and on the same side of the wash. A small unit of at least four rooms and two kivas of middle Pueblo III time was indicated.

Standing upright on the bottom of the ventilator opening in one of the kivas was found a sandstone phallus measuring 9¼ inches in height. It was oval in cross-section and measured 8×7 inches at the base. The bottom was irregular, but the rest had been carefully carved and smoothed to represent most realistically the end of a phallus when erect. The specimen is now at the University of New Mexico in Albuquerque.

This find is unique for the southwest, as far as the author has been able to ascertain either in conversation or from the literature. The author would suggest that, in view of the general similarity of shape, this phallus represents the basic idea behind the "corn goddess" or "earth goddess" symbols that have been found at Pecos, Cliff Palace, Red Paint Canyon, and in the La Plata district. The cones of smooth sandstone from Square Tower House, Bc-51 (Chaco Canyon), and Gallina probably embody the same idea. The modern version is the plume holder.

The fertility symbolism of these stones has long been recognized, but their possible phallic meaning has been neglected while their similarity in shape to an ear of corn has been emphasized. As they are all reported as smooth, i.e., not marked to represent

[10] Paul Reiter, Personal interview, February, 1942.

[11] J. A. Jeançon, "A Rectangular Ceremonial Room," *The Colorado Magazine*, Vol. 3, No. 4, 1926, pp. 133–137, Figs. 1–3.

[12] Through recent work at Santa Clara, Dr. W. W. Hill has identified this room as one adjacent to and connected with the residence of the Winter Cacique. Personal interview with Dr. Hill, February, 1942.

[13] E. C. Parsons, *Pueblo Indian Religion* (Chicago, University of Chicago Press, 1939), p. 365.

Specimens from Ohio. *Upper*, Mound City otter pipe; *lower*, the Allen tablet.

kernels, it seems possible that phallicism is the basic root of the symbolism represented.

RIPLEY P. BULLEN
Andover, Massachusetts

TWO NEW SPECIMENS FROM OHIO

During the course of field-work in the summer of 1942 two specimens unusual enough to warrant special notice have been located in private collections.

THE ALLEN TABLET

About 1900 a small mound was opened on the Marion West farm near Saxon, Meigs County, Ohio, along the Ohio River. Mr. West found the inscribed tablet (Pl. XXXIX, *lower*) in this mound. The specimen was obtained shortly afterward by Mr. Richard Allen of Columbus, Ohio, in whose collection it is now preserved. This Adena tablet depicts the conventionalized bird design found on several other specimens of this type. It is particularly reminiscent of the Cincinnati and Richardson tablets. The Allen tablet is 8.9 cm. long, 1.9 cm. thick, and 5.1 cm. wide. It is slightly concavo-convex in cross section.

MOUND CITY OTTER PIPE

E. G. Squier and E. H. Davis made a partial examination of the Mound City Group at Chillicothe in Ross County, Ohio, in 1846. From Mound 8 they removed approximately two hundred stone pipes, the majority of which were carved into effigies of birds, animals, and human figures. These pipes are now in the British Museum. In 1920 the Ohio State Museum completed the examination of this mound group and eight more of these effigy pipes were found. During World War I an army encampment, Camp Sherman, occupied the site of Mound City and several barracks were built over the mounds. This construction work uncovered many artifacts, but most of them were lost or destroyed. One of the few things preserved is an unbroken effigy pipe picked up by one of the soldiers. This specimen is now in the collection of Albert L. Addis of Wolflake, Indiana.

The pipe is of fawn-colored Ohio pipestone carved in the effigy of an otter (Pl. XXXIX, *upper*). Instead of being ceremonially broken, as is usually the case, it was deliberately mutilated at the time of burial by gouging with a sharp-pointed instrument. Both ends of the platform on the upper side, the mouthpiece on the lower side, and both sides of the head are covered with short but deep gouge marks, serving to destroy the beauty and fine workmanship of the specimen.

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A CORNER-TANG ARTIFACT FROM OREGON

During the cataloging of a collection of some 650 tiny projectile points from the banks of the Columbia River in Columbia County, Oregon, an unusual specimen was brought to light.[1] All but five of the points in the collection are under ¾ inch in length and are proportionately narrow and thin. The five larger specimens were, then, immediately outstanding. Of these, one is of the corner-tang variety.[2] It is 2.13 inches long,

[1] The collection was made over a period of years by the late Col. Joseph W. Day of St. Helens, Oregon, and was kindly given to the Oregon State Museum of Anthropology at the University of Oregon by Mrs. Irene M. Day.

[2] J. T. Patterson, *The Corner-Tang Flint Artifacts of Texas*, University of Texas Bulletin, Anthropological Papers, Vol. 1, No. 4, 1936.

1 inch wide, and 0.36 inch thick. It is made from a tan, slightly opalitic chalcedony,[3] a material which is quite common in the collections of chipped stone artifacts from the lower Columbia River area.

The specimen is of the type that Patterson has called "diagonal corner-tang"[4] and possesses a small crescent notch on the side opposite the tang. The tang is quite narrow and pointed. The chipping is somewhat rough and uneven, and on one side there appears to be something of a channel groove running approximately two-thirds the length of the specimen. This is, in all probability, quite accidental.

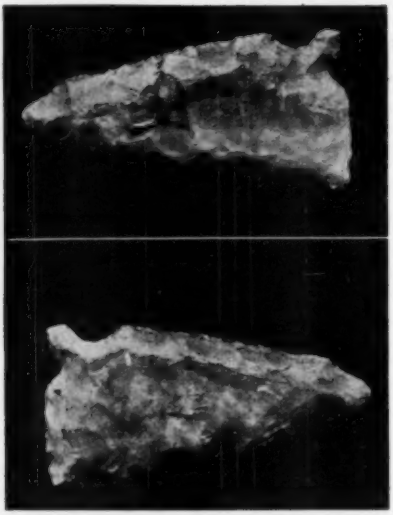

FIG. 35.—Corner-tang artifact from Oregon (*Natural size*).

To the writer's knowledge, no other corner-tang artifacts have heretofore been reported from west of the Rocky Mountains and only a very few from anywhere east of the Mississippi River.[5] The concentration of this type of specimen (probably, as Patterson says, they should be referred to as blades or scrapers)[6] seems to be in central Texas, with a small secondary concentration in Wyoming and two specimens reported from as far north as Montana.[7] The origin of the Oregon specimen is unknown, it may represent an independent invention in that area or it may have been intrusive across the mountains

[3] Identified by Dr. Lloyd W. Staples, Asst. Professor of Geology at the University of Oregon.

[4] Patterson, *op. cit.*, p. 10. See also Pl. 5, Fig. 21.

[5] H. E. Fischel, "A Note on Corner-Tang Artifacts," AMERICAN ANTIQUITY, Vol. 4, No. 2, 1938.

[6] On the basis of their hafting equipment, Patterson's suggestion as to their use seems reasonable. However, the writer fails to see any reason to suppose an evolutionary development of the four types from "the common spearhead type of knife" (see Patterson, *op. cit.*, p. 26) other than pure speculation. Nor can he understand why the type could not possibly have developed in an agricultural area. Is it impossible for an agricultural people to use cutting or scraping tools?

[7] J. T. Patterson, *Supplementary Notes on the Corner-Tang Artifact*, University of Texas Bulletin, Anthropological Papers, Vol. 1, No. 5, 1937.

from the east. On the other hand, other specimens of this type may occur in the far western states without having been reported to date.

The present specimen represents a surface find and there is no evidence upon which to base any conclusions regarding its age or associations.

It is hoped that any further occurrences of this type of specimen in the western states will be noted and reported and that its cultural associations may soon be established. At present the corner-tang type of artifact is in somewhat the same position as are the Folsom and Yuma types, that is, as a sort of unknown "floater" in both time and space.

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FURTHER LIGHT ON "WOODEN TUBES" FROM OREGON

In AMERICAN ANTIQUITY for July, 1940, there appears a short article by Robin Drews, of the University of Oregon, entitled "Peculiar Wooden Tubes from Southeastern Oregon," in which the author asks if these tubes may be "beads, gambling pieces, pipe stems, or what?" Recently I noted a scrap of ethnobotanical information which reminded me of this query and which, I feel, may throw some light on the subject.

Frederick V. Coville, in his "Notes on Plants Used by the Klamath Indians of Oregon,"[1] has the following to say of the Blueberry Elder (*Sambucus caerulea*): "One curious use of the plant, now rarely resorted to, but formerly common among the Snake Indians, consists in punching out the pith from sections of the stem, ramming them full of large crickets, *Anabrus simplex* Hald., and plugging the ends. The contents of the stems were used for food in the winter" (p. 104).

In the original query there is no identification of the wood of which these tubes were made, but the statement that "the pith had been removed, leaving a clean bore" is not inconsistent with the assumption that they may have been of elder.

The facts that no crickets were mentioned as being found in them and that the ends were not plugged might indicate either that the tubes had been prepared for use in this way but never actually used, or that the contents had been eaten and the tubes left where they were found. However, we are informed that in two cases sinew binding was still in place, so the first assumption is more likely the true one.

The "Snake Indians" referred to by Coville are listed in Bulletin 30 as follows: "Snakes. A name applied to many different bodies of Shoshonean Indians, but most persistently to those of E. Oregon. . . ." Here, too, there is no incompatibility, since the Catlow Valley, where the tubes were found, is in southeastern Oregon, and in Shoshoni territory.

It seems reasonable, therefore, to suppose that these wooden tubes may have been used as receptacles for crickets or other food stored for winter use.

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[1] *Contributions from the U. S. National Herbarium*, Vol. 5, No. 2, 1897, pp. 87–108.

WAS TOBACCO SMOKED IN THE PUEBLO REGION IN PRE-SPANISH TIMES?

In discussing recently the modern cultivation of tobacco among the Pueblo Indians,[1] Leslie A. White remarked that "archaeologists have no evidence of the use of tobacco

[1] Leslie A. White, "Further Data on the Cultivation of Tobacco among the Pueblo Indians," *Science*, Vol. 96, No. 2481, July 17, 1942, pp. 59–60.

among the Pueblos in prehistoric times." He further added that it seems that "tobacco was not used among the Pueblos prior to the advent of the white man." These statements are counter to the rather firmly established opinion that tobacco must have been smoked in the pipes which are found in archaeological sites in the Southwest. As rumblings of consternation and dissent have been provoked by White's remarks, it seems in order to review briefly some of the data relative to this question.

Less surprise might have been occasioned had White worded his remark to read that no *direct* or *tangible* evidence of tobacco has come from archaeological sites in the area. In the considerable quantities of prehistoric ethnobotanical materials from the Pueblo region proper which I have examined, I have found no tobacco. As will be noted later, I have identified one specimen from the Gila region as tobacco. In the extensive literature there seem to be no reports of the finding of tobacco in Anasazi sites. It is equally true that direct evidence of any alternative smoking materials seems to be lacking also. Don Watson[2] wrote that it has been claimed that leaves of the Oregon boxwood (*Pachystima myrsinites*) have been found in archaeological pipes from the Mesa Verde area. On further inquiry, he replied[3] that he was unable to find any satisfactory evidence to support this and that the stories must be considered as legends handed down from the old-timers.

Although unburned smoking materials seem not to have been found in pipes from the Pueblo region, dottel or "cake" is sometimes found in them and might seem to offer identifiable evidence of the material smoked. In this form, however, the material has no plant structure remaining and is not susceptible to identification by botanical means. Dixon and Stetson in 1922[4] reported on the chemical analysis of dottels from Basketmaker pipes. The analyses were negative for nicotine. The conclusions drawn were that either the material smoked was not tobacco or, if it was tobacco, the nicotine content had leached out in the course of time. Although these tests were inconclusive, it might be worthwhile to attempt to interest chemists in making further analyses.

Pipes are often found in sites representing all of the Anasazi periods, but indications as to what was smoked in them are lacking. Linton in 1924,[5] in discussing Basketmaker pipes, remarked that it was impossible to tell whether tobacco was used in them, and the continued lack of data is reflected in McGregor's statement in 1941[6] that he knows of no information as to what was smoked in pipes of the Basketmaker II period. The remarks of these writers could just as well be extended to apply to pipes of any Anasazi period, instead of only to those from Basketmaker sites. It thus appears that archaeology furnishes no direct evidence as to the nature of the prehistoric smoking materials of the Pueblo region. Any opinion on this matter must be derived then by inference from practices recorded in history and in ethnography.

In recent times, tobacco has been smoked by North American Indians so universally that it has become customary to assume that pipes, wherever found, may be construed as evidence of the smoking of tobacco. A great many other things, however, can be and have been smoked in pipes. West[7] discusses at some length the many materials which Indians mixed with tobacco or smoked alone, and in summarizing these says: "It is thus quite clear that among many aboriginal peoples the fact of smoking was in nowise

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[2] Letter to Leslie A. White, October 23, 1941.

[3] Letter to Volney H. Jones, December 8, 1941.

[4] R. B. Dixon and J. B. Stetson, Jr., "Analysis of Pre-Columbian Pipe Dottels," *American Anthropologist*, Vol. 24, No. 2, 1922, pp. 245–246.

[5] R. Linton, *Use of Tobacco among the North American Indians*, Field Museum of Natural History, Anthropology Leaflet, No. 15, 1924, p. 11.

[6] J. C. McGregor, *Southwestern Archaeology* (New York, John Wiley & Sons, 1941), p. 220.

[7] G. A. West, *Tobacco, Pipes and Smoking Customs of the American Indians*, Bulletin of the Public Museum of the City of Milwaukee, Vol. 17, 1934, pp. 105–116.

a presupposition of the exclusive or even of the extensive use of tobacco." Indeed, he might have gone farther and added that pipes and smoking are not necessarily an indication of tobacco at all. At least, considerable caution should be exercised in interpreting pipes as prima facie evidence of tobacco.

The accounts of the early Spanish expeditions into the Southwest might be expected to offer data pertinent to the present problem. Strangely enough, they seem to be silent not only on smoking materials, but apparently contain no references even to smoking. I have yet to find any reference to smoking in the accounts of such early writers as the chroniclers of the expeditions of Coronado and Espejo. Several documentary historians to whom White[7a] wrote for information were unable to furnish any sixteenth century references to smoking in the region. McGuire[8] gives little space to the Southwest in his section on early references to tobacco, but does remark that Marcos de Nizza failed to to mention smoking. This lack of evidence seems significant, especially as McGuire cites many early accounts for other regions such as the West Indies, Peru, Mexico, and eastern North America.

From the apparent absence of references to smoking in the Pueblo region, it may be concluded either that smoking was not practiced or that, if practiced, it was very inconspicuous. The former conclusion hardly seems warranted, as pipes are found archaeologically up through the later periods, and their use has been recorded ethnologically. There is no reason to suspect that pipes have not been used continuously. If, however, their use was restricted to ritual in ceremonial chambers, they might well have escaped the notice of the early Spaniards. The belief that they may have been used only in such manner is consistent with ethnological data, which indicate that pipe smoking among the Pueblos has been associated only with ceremonies. In ceremonial gatherings smoke is blown to the different directions and over sacred objects. It seems likely that any prehistoric use of pipes in the Pueblo region was also of this nature, rather than for non-ceremonial personal smoking. If so, what can be inferred as to the materials smoked in them?

Bandelier, in the *Delight Makers*,[9] in which he strove for scrupulous ethnographic accuracy, stated that smoking among the prehistoric pueblos was "not a relish but exclusively a sacrifice," remarking that tobacco was unknown to them and that "red willow" bark was the only thing used for smoking. In his *Final Report*[10] he reiterated that tobacco was unknown among the Pueblos until Spanish rule became established, and implied that it was unknown anywhere in the Southwest. He gave no basis for these opinions, but they are probably based on his extensive documentary researches. However well founded they may be otherwise, his selection of "red willow" (*Cornus stolonifera?*) bark as an alternative for tobacco lacks substantiation. It was a prominent smoking material in the Plains and eastward, but the plant is rare in the Southwest and seems not to have been associated with smoking there by any other authors.

Probably a rather long list of materials burned ceremonially in pipes by Pueblo Indians could be compiled from ethnological sources. The "cloud tobacco" of the Hopi, as described by Stephen in 1891,[11] is probably typical of these. This was composed of wild tobacco and leaves of spruce, pine, and aspen, all gathered ceremonially. Other

[7a] See, however, his recent article, "Punche: Tobacco in New Mexico History," *New Mexico Historical Review*, Vol. 18, No. 4, 1943, pp. 386–393, published since this was written, which contains two early 17th century references to the use of tobacco in New Mexico.

[8] J. D. McGuire, "Pipes and Smoking Customs of the American Aborigines, etc.," *Report of the U. S. National Museum for 1897*, 1899, pp. 351–645. See pp. 401–424.

[9] A. F. Bandelier, *The Delight Makers* (New York, Dodd, Mead & Co., 1890), pp. 49–50.

[10] A. F. Bandelier, *Final Report of Investigations among the Indians, etc.*, Papers of the Archaeological Institute of America, American Series, No. 3, Cambridge, 1890, Pt. 1, p. 37.

[11] A. M. Stephen, *Hopi Journal of Alexander M. Stephen*, edited by E. C. Parsons (New York, Columbia University Press, 1936), footnote, p. 599.

authors also indicate that the cloud-blowing material was usually a mixture of plants with aromatic properties. In modern accounts, tobacco is prominent among Pueblo smoking materials, but it is by no means the only one and is generally mixed with other plants. *Nicotiana attenuata* and other species of tobacco grow wild in the Southwest and are readily available in the small amounts needed for ceremonial purposes without cultivation. It can be presumed that tobacco was similarly available in archaeological times, at least from the beginning of the Anasazi period. There is thus no reason why tobacco could not have been smoked in the archaeological pipes and there is rather strong inferential basis for the belief that it was smoked in them. It would not be reasonable, however, to consider it as the exclusive material, or to assume that pipes necessarily mean tobacco.

Judging from the modern descriptions of ceremonial "smoking," it is quite different from the smoking for pleasure which we usually think of. In the light puffing of the ceremonial pipe no physiological effects would be likely to be felt and probably none would be desired. Pueblo religion has rejected such narcotics as peyote and the red bean. The sacred qualities of plants for ceremonial smoking would be assigned to them by their users and would depend to only a limited extent on their inherent properties. Thus, a narcotic plant such as tobacco would not be required, and tobacco, if used, probably was prescribed more for its pungency and smoke-producing properties than for its physiological effect. In historic times, in the Pueblo region, pipes have not been used for personal or secular smoking and probably were not so used in prehistoric times. Linton[13] considers that the heavy "cake" or dottel noted in some Basketmaker pipes indicates personal as well as ceremonial smoking, but it seems reasonable to suppose that prolonged ceremonial smoking could have produced such dottel.

Tobacco has also been used ceremonially in the Southwest in the so-called "ceremonial cigarettes." These are sections of reed grass in which various sacred materials are placed and whose exteriors are prepared with symbolic decorations and attachments. Stephen[14] illustrates and describes Hopi examples of these, listing their contents as tobacco, corn pollen, and "minute yellow feathers." He says[14] that these will be "smoked" (feathers and all!), but does not describe the manner of smoking. Cushing[15] tells of a somewhat similar Zuñi "cane cigarette" filled with tobacco and describes the ritual of puffing it to the directions and its deposit as an offering. Such "cigarettes" are often found in shrines and ceremonial caves, particularly in the Gila region. Hough[16] describes and illustrates a large number of these, interpreting them as "symbolic offerings of incense." He describes their contents as "fragments of aromatic herbs, such as artemisia, and other plants not determined," but does not mention tobacco. I found what I took to be tobacco in specimens from Casa Grande submitted to me by Steen,[17] but the fragmentary condition of the material makes the identification somewhat uncertain. This is the only archaeological record of tobacco in the Southwest known to me, and it is not for the Pueblo region proper.

Although these "ceremonial cigarettes" sometimes contain tobacco and are "smoked," they can be considered primarily as prayer offerings rather than as smoking utensils. Hough says that only a relatively few of those which he found were pierced through the septum and had been smoked. Of about two hundred in the Casa Grande

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[13] *Op. cit.*, p. 11. [14] *Op. cit.*, Fig. 102, p. 172. [15] *Op. cit.*, p. 75.

[15] F. H. Cushing, *Zuni Breadstuff*, Museum of the American Indian, Indian Notes and Monographs, Vol. 8, 1920, pp. 162–164.

[16] W. Hough, *Culture of the Ancient Pueblos of the Upper Gila Region, etc.*, U. S. National Museum, Bulletin 87, 1914, pp. 107–111.

[17] C. R. Steen, "Ceremonial Cigarettes," *National Park Service, Southwest Monuments Monthly Report, Supplement*, October, 1935, pp. 287–291.

collection, Steen reports that only about 20 per cent are punctured at the node and that only three show signs of burning. In view of these facts, it seems strange that Linton[18] discusses these reed "cigarettes" as if they were habitually smoked and refers to the "hundreds of charred butts" of them found in sites. It seems clear that, regardless of the number of them which may have been "smoked," the burning of them was ritualistic and not for pleasure (bird feathers!), and that they were not smoked on secular occasions for physiological effect. Although tobacco seems to have been at least an occasional inclusion, again it was not the only material and it was not required for its narcotic effect. The term "ceremonial cigarette" commonly applied is unfortunate and misleading. Some name such as "prayer tube" would be more apt.

Linton[19] points out that archaeology indicates that the prehistoric smoking in the Southwest was of pipes and reed cigarettes, and suggests that the corn husk cigarette may have been introduced from Mexico during the early historic period. It is my impression that corn husk cigarettes still have not been reported from sites in the region, and further support for Linton's suggestion might be found in the greater use of the corn husk cigarette among the Rio Grande pueblos, where Mexican influence is strong, and their apparent absence among the less affected Hopi. It would not be strange if the Spaniards influenced the smoking pattern here, as they were active in the dissemination of smoking elsewhere. McGuire[20] remarks on the apparent impetus given by them to smoking along the coast of the Gulf of Mexico, in Chile, and in other parts of South America.

The corn husk cigarette appears to be used more at political meetings and on other secular occasions, while the pipe is typical of ceremonies. At least, the pipe is not used for personal smoking outside of ceremonies. It is true that in recent times the cigarette has become a ceremonial smoke and at Zuñi seems to have replaced the pipe entirely. Stevenson[21] considers, however, that the pipe was originally the vehicle of ceremonial smoking there. The Tewa appear to maintain a marked separation of ceremonial pipe smoking and non-ceremonial cigarette smoking.[22] If this separation is valid for the Pueblos in general, a good case for the Spanish introduction of secular smoking might be made. In such smoking with cigarettes, the physiological effect would be the prime consideration and a narcotic such as tobacco would be required, giving considerable stimulus to the use of tobacco. Anyhow, there is a wide gap in motive and practice between puffing aromatic herbs for ritualistic purposes and smoking cigarettes for their physiological effect.

It is obvious that the evidence drawn upon in this discussion leaves much to be desired in the way of definiteness and that, in lieu of exact data, it has been necessary to engage in much speculation. It is hoped that this discussion has at least called attention to the problems involved and the nature of the data needed. In so far as the present evidence goes, certain tentative conclusions seem warranted:

No direct evidence of tobacco or other smoking materials has been reported from archaeological sites in the Pueblo region.

Pipes found in archaeological sites in this region probably were used only in ceremonial smoking, in which a narcotic was not required.

Tobacco may have been one of the sacred materials smoked in these pipes, probably in combination with other materials.

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[18] *Op. cit.*, p. 9. [19] *Op. cit.*, p. 9. [20] *Op. cit.*, pp. 403, 405, 412–413.

[21] M. C. Stevenson, "Ethnobotany of the Zuni Indians," Bureau of American Ethnology, *30th Annual Report*, 1915, pp. 31–102. See p. 95.

[22] W. W. Robbins, J. P. Harrington, and B. Freire-Marreco, *Ethnobotany of the Tewa Indians*, Bureau of American Ethnology, Bulletin 55, 1916, p. 104.

It does not seem safe to assume that pipes are prima facie evidence of tobacco smoking.

The so-called "ceremonial cigarette" should be considered as a prayer offering rather than as a smoking utensil.

The corn husk cigarette, and possibly secular smoking in the region, may have been of Spanish introduction.

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A QUIACKESON HOUSE IN EASTERN MARYLAND

In the July, 1936 and January, 1937 numbers of AMERICAN ANTIQUITY, under the head of "Correspondence," there were published certain data, bearing mostly on the subject of the burial customs of the Indians of eastern Maryland, which I had gathered together from several contemporary sources. In this connection I called attention to the occurrence in Maryland, Virginia, and North Carolina of place-names of more or less ancient date which embody the word "quiackeson," or another of its various forms, giving this as evidence of the former existence of the mortuary temples called "quiackeson houses" in those places. Very recently, at the State Land Office in Annapolis, I came across a land record in which a quiackeson house is mentioned and which reads as follows:

> Henry Dorman's cert. 50 acres. Quiakeson Neck. Pat^{d}. 14 Nov. 1738. surveyed 15 Feb. 1734, by David Wilson, surveyor, somerset County. scituate lying & being near the heads of the Branches of Wiccocomocow River bounded as follows Begining at a marked white oak standing on the North side of the Main Branch of the said Neck about sixty yards from the side of the afs^{d}. Branch & near the ffork of the afs^{d}. neck *where a Quiakeson house formerly stood*, etc., etc.[1]

The site of this quiackeson house has not been ascertained. The land in question now lies in Wicomico County. The Wicomico River is a tidal estuary as far as the city of Salisbury, the largest town of the "Eastern Shore" of Maryland. Several freshwater streams, the largest of which bears the name of the river, unite at Salisbury. "Quiakeson Neck" does not lie near Salisbury. Original land-grants in and about that place are known to this writer. In all probability the land now under consideration lies near the head of the main (fresh) branch of Wicomico River, not far from the borders of Delaware.

While too few to permit one to come to any conclusion as to the character of the places generally chosen for the sites of quiackeson houses, these records leave one with the feeling that solitude, remoteness, or isolation was considered essential, and that swamps, islands or out-of-the-way necks were preferred to more frequented spots.

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[1] Land Office of Maryland, Patent Records for Land, Liber E. I. No. 5, folio 327.

BOOK REVIEWS

The Irish Stone Age, Its Chronology, Development, and Relationships. HALLAM L. MOVIUS, JR. (Pp. xxiv+339, 59 text figures, 7 plates, 7 tables. Cambridge University Press and The Macmillan Co., 1942. $7.50.)

During the years 1932 to 1936 the Division of Anthropology at Harvard University carried out a survey of the physical anthropology, sociology, and archaeology of Ireland for the purpose of studying the origin and development of the races and cultures of Ireland. The present volume deals with one part of the archaeology—the Stone Age. Six sites belonging to this period were excavated. The study goes far beyond a description of the material and a discussion of the immediate problems and treats, partly in great detail, the late glacial and the post-glacial geology and chronology of Ireland, Britain, and Scandinavia, as well as the relationship of the human cultures to the environment in which they were evolved.

The first part of the volume, pages 1–102, and an appendix deal with the late Quaternary geochronologies of Scandinavia, the late glacial geological sequence in Britain and Ireland, and the early post-glacial chronology of Britain and Ireland. It summarizes Gerard De Geer's and Ragnar Lidén's late glacial and post-glacial chronologies based on varved (annually laminated) clays, the main stages of the Baltic during the past 12,000 years, and the climatic ages and the vegetational stages and zones of Scandinavia. Since Professor Knud Jessen of Copenhagen studied the pollen-bearing deposits at Dr. Movius' sites, and since the conditions in Ireland probably have their closest relationship in Denmark, the climatic ages, the vegetation stages, and the dates given are those distinguished and applied in Denmark, which differ slightly from those for Sweden. The beginning of the post-glacial age is, after Jessen, put at the end of the last solifluction layer in Denmark (p. 21), which Jessen correlates with the beginning of the ice retreat from the central-Swedish moraines and the Salpausselkä. This Danish division would be good for a limited region, if the age of the upper arctic solifluction layer in Denmark were known. However, since the Swedes and the Finns will certainly not refer most of their glacial deposits to the post-glacial age, it is not applicable to Fenno-Scandia. And, because the directly preceding subarctic Allerød beds of the southwest Baltic region and of Ireland (pp. 67, 68) have no known correlatives in America, those among us who attempt to apply Swedish dates in this continent cannot accept this division. At the time of the bisection of the ice sheet remnant at Stugun in northern Sweden in the year 6839 B.C.,[1] which is the division point between the Glacial and the Post-glacial for Fenno-Scandia, the temperature in central Sweden and Finland had about reached its modern level. Therefore the attainment of modern temperatures in the greater parts of the once glaciated areas in the northern hemisphere may be used as a time boundary —as the beginning of the Post-glacial. In the glaciated areas the Post-glacial then began about 7000 B.C., while far to the south, as in the southern United States, it may have begun at roughly 8000 B.C.

Movius makes a thorough bibliographical study of the glacial deposits and of the last deglaciation in Britain and Ireland, which he correlates with drifts and with the last ice recession in northern Germany and in Scandinavia. He goes into some detail concerning the stages of ice retreat and of halt in the two areas. The late glacial plant succession, as revealed by tree pollen, is the same in Ireland and in Denmark (pp. 65, 68); and Movius finds a complete parallelism in deglaciation and climatic history between

[1] Ragnar Lidén, "Den senkvartära strandförskjutningens förloop och kronologi i Ångermanland." Geologiska Föreningens i Stockholm Förhandlingar, Band 60, 1938, pp. 397–404. See p. 403.

Ireland and Scandinavia (p. 70). A survey of the principal geological events and conditions and of the climatic history during the post-glacial age confirms the late glacial correlation and extends it to include the entire Post-glacial. Thus the Swedish geochronology and the dated Scandinavian climatic ages can be applied to Britain and Ireland (p. 102). "This is of special importance with regard to fixing the age of archaeological deposits, especially in Ireland where the material cannot be dated through direct cultural affinities with the Continent. Thus the Irish Stone Age may now be placed in its proper context with relation to contemporary cultures in other regions" (p. 102).

Claims for an Irish Paleolithic do not stand up under scrutiny, but, according to present knowledge, the immigrants to Ireland were descendants of Upper Paleolithic hunters with an industry that was closely related to the Early Mesolithic (pp. 105, 120, 143, 207). The migrants came from southern England, where they had survived the last Glacial, and they were reinforced by Azilians from southern France and northern Spain. They arrived during the Boreal age, at perhaps roughly 6500 B.C., when only a narrow channel separated Ireland from Britain. In the flint region of northeast Ireland a new Mesolithic industry, called the Larnian for Larnia, north of Belfast, was evolved (pp. 126, 209). The sites of this culture are associated with post-glacial marine deposits or raised beaches. The preserved implements are almost solely of flint, though bone and antler tools must have been used (p. 171). The Early Larnian includes an overwhelming proportion of finely-struck blade implements. Also typical are core scrapers, thumb-nail scrapers, awls, and Cushendun picks (p. 173). The culture was evolved in a low coastal land with swamps, meadows, and woods; and it was based on an economy of hunting, fishing, and food-gathering. The principal game animals may have been Irish elk, red deer, wild boar, and wild fowl.

With the Littorina transgression, the low occupied land became inundated by the sea, and this physical change was accompanied by a cultural change (p. 172). New tools were developed which suggest that fishing and the collection of edible molluscs replaced hunting as the principal source of sustenance. Settlement was still concentrated on the coast. Typical implements were coarse, heavy flake and blade tools, choppers, concave scrapers, etc. (p. 174).

At the end of the moist Atlantic age, or during the centuries between 3000 and 2500 B.C., two cultural influences reached Ireland (pp. 211, 255). One came by the sea from the southwest, and consisted mainly of a Megalithic culture. The other came via Britain from northern France and was Campignian. Driven away from the desirable coastal region on the North Channel by the invaders from England, the Larnian people in early Sub-boreal time moved inland and to the west coast. One important settlement was established on the lower Bann River in northern Ireland, where, influenced by the Megalithic and Campignian industries, a culture was evolved on the basis of the Late Larnian. In the coastal sand dune areas of northern and western Ireland other Larnian descendants retained a food-gathering economy into the Christian era.

The Irish Stone Age is a detailed, comprehensive, well documented, and really impressive monograph. The geological and climatic correlation of Britain-Ireland with Scandinavia is the best ever made. Future research may modify some of the dates applied to the Irish Stone Age cultures, but those given can be regarded as approximately correct.

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Flintlocks of the Iroquois, 1620–1687. JOSEPH R. MAYER. (Research Records, Rochester Museum of Arts and Sciences, No. 6, 59 pp., 17 figures, 5 plates, 1 map. Rochester, 1943.)

That archaeology in America is beginning to pay attention to datable historic sites and to trade implements is an encouraging portent. Archaeology of the American Indian need no longer be concerned exclusively with work in various mediums—in stone, bone, etc.—recognized as belonging to the aboriginal level. For recent studies in ethnohistory have directed attention to the contact period and to the importance of the fur trade as the means of introducing the ax, the gun, and the metal kettle, and to their influence on the fortunes of New World peoples. Therefore, the present study, *Flintlocks of the Iroquois, 1620–87*, reminds us once again that the amazing success of these famous woodland warriors was a phenomenon of the contact period. Their military conquest coincided with their political and economic pre-eminence as middlemen in the fur trade between the far Indians and the competing nations of the white traders.

This study is based on 198 gun artifacts collected from the surface or excavated from adjacent cemeteries at the four Seneca town sites south of Rochester which were sacked by Denonville in the summer of 1687. It will interest archaeologists to learn that Dr. Mayer, a physician, believes that were it not for this time ceiling the gun locks could not be accurately placed as prior to that year, "since diagnostic criteria in the objects themselves are patently unreliable . . ." (p. 6). He feels constrained to fall back on the documentary evidence of "economic necessities, political pressures, and military campaigns of the period. . . ." Accordingly, his exposition of the historical background consumes eleven pages, which are devoted to an intimate account of Denonville's expedition, the aborigines, trade factors, the wars of the Iroquois, the Peace of 1653, and the French punitive campaigns other than Denonville's. Hunt and others have already painted this canvas in broad strokes,[1] and Mayer follows Hunt closely except for the latter's appendices on the Dutch and French trade in firearms, where it is shown how relatively few guns were in the possession of the Iroquois when they dispersed the Huron in 1648–49. Incidentally, there is a minor error of four years in the date given for this campaign (p. 13), and Hunt is probably best qualified to criticize the extended chapter on "Documents Relating to the Trade in Munitions" (pp. 44–57).

The route of Denonville's expedition traverses ground familiar to a resident of the Genesee country, and consequently Mayer's estimate of the destruction wrought and the locations of towns are of value. For instance, Parker[2] and the reviewer[3] had repeated an original error of O'Callaghan, editor of the New York Colonial Documents, in converting Denonville's estimate of corn destroyed at four Seneca towns from *minots* to bushels.[4] Mayer gives 52,000 bushels.

Moreover, Mayer assigns the name "Totiakton II," which Houghton had reserved

[1] George T. Hunt, *The Wars of the Iroquois*, Madison, 1940.

[2] A. C. Parker, *Iroquois Uses of Maize and Other Food Plants*, New York State Museum, Museum Bulletin 44, 1910, p. 18.

[3] W. N. Fenton, "Problems Arising from the Historic Northeastern Position of the Iroquois," Smithsonian Miscellaneous Collections, Vol. 100, 1940, p. 230.

[4] Denonville says 350,000 *minots* of green corn and 50,000 *minots* of old corn in cache. The *minot* varied from time to time, from place to place, and according to the thing measured. At one time the *minot* equalled three French bushels. Here is where O'Callaghan fell into error! Actually, the *minot* contains about 39.36 liters and the American bushel about 35.2. Nevertheless, 55,000 bushels of corn is still a lot of corn for 5000 persons to have in storage; and 440,000 bushels might crowd the elevators of modern Rochester! However, since Sullivan a century later reported that the quantity of corn alone destroyed by his armies in 40 towns of the Cayuga and Seneca country, according to a moderate computation, amounted to 160,000 bushels, the above estimates may not be excessive.

for another town, to the Dann farm site. These details are trivial, however, and the treatment and description of the flintlocks themselves are sufficiently illuminating to make us hope that Dr. Mayer may extend some of his love for firearms to the more humble appurtenances of Seneca village life. The large number and great variety of iron tools found on these seventeenth century sites, indicating that the trade in implements was exceeded only by that in arms, still await description; they include hatchets, hammers, knives, saws, vises, chisels, draw shears, pliers, scrapers, files, and axes (p. 33 ff.). Boughton Hill, site of "Gannogaro," itself merits a book, for what is needed more than studies of single trade items is a thoroughgoing description of the materials from a single one of the four or five historic Seneca village sites which Mayer and his Rochester colleagues know so well among themselves, but which remain so little known to archaeologists and historians in general. Such a report would make an indelible record of the nature of Seneca village life, agriculture, population, and the extent to which trade goods had altered the material culture and economy during the period when the lordly Iroquois were at the peak of their power.

Apparently, we conclude from Mayer's study, the bulk of the trade goods reached the Iroquois towns through Dutch outlets, for "it appears that the guns, powder and lead sent into the Iroquois castles were preponderantly Dutch, with a minor proportion of English manufacture. . . . Although the locks comprising the material for our study do not bear any distinguished mark of national provenance, we are strongly inclined to believe that most of them were fabricated in the shops of the Netherlands and in the armories along the German Ruhr. From thence they were stowed in the timbered holds of the Dutch merchant marine destined for Iroquoia by way of New Amsterdam and Fort Orange" (p. 57).

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The Fauna of Papago Springs Cave, Arizona, and A Study of Stockoceros; With Three New Antilocaprines from Nebraska and Arizona. MORRIS F. SKINNER. (Bulletin of the American Museum of Natural History, Vol. 80, pp. 143–220, 1942.)

This paper is primarily paleontological and is of value to all students of the Pleistocene and early Recent, presenting as it does a thorough account of a late Pleistocene fauna recovered from an Arizona cave. To archaeologists, it also has significance, though from a different point of view. In 1939 Dr. Edwin Colbert and Robert Chaffee[1] announced that in the Papago Springs Cave the bones of extinct *Stockoceros onusrosagris* (an antelope) as well as extinct horse had been found in association with pottery fragments and artifacts. Inasmuch as the potsherds date into the Christian era, this discovery would have placed a surprisingly late date upon a supposedly Pleistocene fauna.

The expedition of which Mr. Skinner was a member sought to explore and exploit fully the possibilities of the cavern, whose arrangement made paleontological work exceedingly difficult. By dint of perseverance, however, it not only recovered much additional faunal material of great value, but also discredited entirely the view expressed in the 1939 paper of Colbert and Chaffee, which view seems to have arisen out of a misunderstanding. The first fossils in the cave were found by Quentin Roosevelt and J. W. Burden,[2] who mentioned finding evidences of fire and pieces of pottery. Later, when certain of the bones collected by Roosevelt and Burden turned out to be those of extinct

[1] "A Study of Tetrameryx and Associated Fossils from Papago Springs Cave, Sonoita, Arizona," *American Museum Novitiates*, No. 1034, 1939, pp. 1–21.

[2] *American Museum Novitiates*, No. 754, 1934.

forms, Colbert and Chaffee seem to have taken this statement to mean that an association had been demonstrated.

Skinner's party worked the whole site out with great thoroughness. It recovered evidences of human occupation, but nothing suggesting an early intrusion of man into the cave. Instead, the archaeological material is all referrable to late horizons and checks in with Roosevelt's and Burden's finds. Nowhere in the cave was there evidence that the extinct animal remains were associated with man. Rather, the artifacts were all recovered "from the Recent dust lying on the older fossiliferous matrix." The fauna associated with the pottery fragments consist of species still known from that region today. The discoveries in this cave, in other words, cannot be used to establish the survival, into recent centuries, of a Pleistocene fauna.

Mr. Skinner's monograph deserves the attention of archaeologists in this regard, for often an earlier paper in a foreign field will go on being referred to as unchallengeable "evidence" simply because a later clarification of the problem has not been noted. If its title is unrelated to the point in which the archaeologist is primarily interested, he is apt to overlook it. The reviewer has several times had this site referred to him as "proof" of the very late survival of a Pleistocene fauna. Mr. Skinner has made that position, in regard to this particular cave, completely untenable. In addition, he has added much to our knowledge of the late Pleistocene horizon and has appended data on other caves. It is a well-illustrated and useful work.

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SOME PUBLICATIONS OF THE YEAR

UPPER NORTH AMERICA

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Brew, John Otis, *A Selected Bibliography of American Indian Archaeology East of the Rocky Mountains* (Papers of the Excavators' Club 2, No. 1. 90 pp. Cambridge, 1943).

Bryan, Kirk and Claude C. Albritton, Jr., "Wind Polished Rocks in the Trans-Pecos Region, Texas and New Mexico" (*Bulletin Geological Society of America* 53. pp. 1403–1416, 1 pl., 1 fig. New York, 1943).

Bullen, Ripley P., "Proposed Drill Classification" (*Massachusetts Archaeological Society Bulletin* 4, No. 3. p. 48. Boston: The Society, 1943).

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Bullen, Ripley P. and David H. Howell, "Spectrographic Analysis of Some New England Steatite" (*Massachusetts Archaeological Society Bulletin* 4, No. 4. pp. 62–64. Boston: The Society, 1943).

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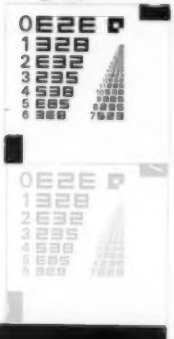
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